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A Basis for Reducing Labor Turnover

By A. J. Zimmerman
Bausch & Lomb Optical Company

INDUSTRIAL developments in management, materials, equipment and processes all serve to give increasing importance to the personnel element in the manufacturing plant. Stability of employment has become almost as vital to the employer as to the employee. Labor turnover must be kept at a minimum to lower costs. Labor turnover is a problem which can never be settled by any one locality alone. Wide interchange of data and experiences offers the only method of attack which will yield a sound solution. But the effort has been largely hampered at the start by a lack not only of mediums of exchange, but also of fundamental definition of terms, and methods of calculation, so that figures from each plant can be compared directly with those from all other plants.

A special report, "The Calculation of Labor Turnover," prepared by a committee on management terminology of the American Management Association, lists several methods of calculation commonly in use among various industries:

1. Separations (voluntary quits, lay-offs, discharges, transfers) divided by the average number of employees on the payroll.
2. Separations, less lay-offs, divided by the same group as for item 1.
3. Separations, plus transfers, with the same denominator as for the preceding formulas.
4. Separations, divided by full year workers (3,000-hour basis).
5. Separations, divided by the average number of employees at work.

In another report issued by a committee of the American Management Association, in November, 1926, the turnover formula is given as the "average working force for the plant, divided into the total number of plant exits."

A study made of many different reports, magazine articles, and other sources, indicates that the prevailing formula for figuring labor turnover percentage is to take as the denominator the average number of persons on the company's active records, or the number of persons in the company's employ, and for the numerator the total separations, including employees leaving voluntarily, discharges, lay-offs, and those separations which are unavoidable, such as death, retirement, and the like. The terms used, however, all require exact definitions, and agreements must be reached upon the methods to be used in the calculation.

The cost of training a new employee ranges from $50 to $200. Reduction of labor turnover is, therefore, one method to lower plant operating costs. But before a successful program can be developed, standard definitions and a uniform system of calculation are needed. Mr. Zimmerman describes what the Rochester industries have been doing

For example, there are several ways of calculating the average number on the payroll. Some companies take the daily total of employees and divide it by the number of days worked in the year. Others content themselves with the number on a specified day or days at the beginning or end of the month, averaged. In some companies only factory personnel is included in the calculation of labor turnover, while in others the office force is included, but not the salesmen. Still other companies take the entire force, factory, office and salesmen. This last method, it

would seem, should be the one adopted in common by all companies. The entire force, and not a part of it, is the essential figure.

Labor turnover percentage rates are usually expressed on a monthly basis, and if changed to an annual basis, the preceding twelve months are averaged. To make an estimate into the future, it is common to take the monthly rate and multiply by twelve. The Metropolitan Life Insurance Company has another method for arriving at the estimated annual figure. Its practice is to multiply the monthly rate by 365 days and then divide by the number of calendar days in the month represented. In leap year 366 days are used.

Labor turnover reports in individual companies are usually computed monthly, to show conditions clearly from month to month and from year to year. Such reports should show the length of service of the people who leave. The periods of tenure considered significant in each individual company will naturally vary from those fixed by other companies.

Labor Turnover Statistics Advisable

In large companies it seems advisable to compute labor turnover for the organization as a whole, for departments, by sex, and by occupation. There should also be a six-months' résumé and an annual résumé. The extent to which these reports give details will vary with the relative usefulness to the company of the data which they contain. Both the numerical and the graphical methods of presentation are recommended, especially for reports which go into considerable detail.

Industries in Rochester, New York, have co-operated in developing and adopting a series of definitions on labor turnover which satisfactorily meet the needs of the various plants in this locality. These definitions are presented in Table I. The figures in parenthesis in the table refer to the corresponding columns in Fig. 1, which shows the application of such data for the purpose of analysis and comparison among different industries.

In this table of definitions, the section under "Accessions" probably requires no further discussion. It would seem that no confusion could arise regarding these terms. It is on the definitions under the section "Separations" that disagreements are most likely to occur.

A separation is a termination of employment, whether at the instance of the employer or on the initiative of the employee, involving removal of the name of the employee from the company's active records. Separations, however, are of many kinds, and vary in importance, in respect to turnover, with the circumstances surrounding them, the length of employment, and the character and skill of the employee. They are traditionally divided into three main groups, depending on the initiative. If the worker takes the initiative it is a voluntary quit. If the employer takes the initiative it is either a discharge or a layoff.

Separations may also be classified by cause, but it is not easy to assign cause, nor to put the separation into the correct group when assigned. The best classification is a combination, with the major groups determined by the initiative and the minor groups by cause. Attempts have also been made to classify separations as avoidable and unavoidable, necessary and unnecessary, voluntary and involuntary, but such classifications are unsatisfactory. Conditions and opinons differ from time to time, and a cause avoidable at one time may be unavoidable at another. Under the plan recommended, the underlying cause is indicated in the primary classification.

Table 1. Labor Turnover Definitions

I. Accessions	Any person who has been hired, or rehired, and placed at work.
A. New employees (1)†	Those hired for the first employment with the company.
B. Rehires (1)	Those hired following previous employment with the company.
C. Transfers*	
a. Inter-plant	Employees recorded as shifted from one plant to another, both plants being part of the same company, but having separate plant labor turnover records.
b. Department	Employees recorded as shifted from one department to another within a plant having separate department labor turnover records.
II. Separations	
A. Voluntary quits (2)	Any separation on the initiative of the employee.
a. Wages	Dissatisfaction with earnings.
b. Lack of opportunity	Poor chance for more pay or advancement.
c. Working conditions	Disssatisfaction with sanitary, safety or social conditions which can be controlled and changed.
d. Nature of the work	Dissatisfaction with inherent elements of the job which cannot be controlled or changed.
e. Trouble with Supervisors	Disagreement with foremen, or other supervisory authorities.
f. Educational	To attend school.
g. Health	Employee's own physical or mental condition.
h. Leave of absence	Temporary separation other than vacation.
i. Undetermined	No reasons obtainable.
B. Discharges (3)	Any separation on the initiative of the employer because of unsatisfactory work or conduct.
a. Misconduct	Dishonesty, trouble breeding, breaking rules, etc.
b. Irregular attendance	A persistent absence or tardiness.
c. Poor workmanship	Intentional deficiency in quantity or quality of work.
C. Lay-offs (4)	Any separation on the initiative of the employer, without prejudice as to re-employment.
a. To decrease force	Slack work, or change of operations.
b. Temporarily employed	Seasonal employment, short time job.
c. Physical reasons	Employee's physical condition unfits him for any available job.
d. Misfit—Below Standard	Not suitable on original assignment nor for any available job.
D. Unavoidable (5)	
a. Death	
b. Retirement	
c. Marriage (Female)	
d. Family reasons	To stay at home; moving of family; sickness or death in the family.
E. Transfers—Department or interplant*	
a. Promoted	Advanced to better position.
b. Departmental fluctuations	Slack work, or rearrangement of work.
c. Physical reasons	Placed at other work because of his physical condition.
d. Misplaced (other work)	Not suitable on original assignment; shifted to another job.
e. Personal reasons	Upon employee's request.
III. Average number of employees (6)	All employees enrolled, regardless of presence at work.

†Numbers in parentheses refer to columns in Fig. 1, correspondingly numbered.

*This information is useful for internal analysis only.

The value of a classification which takes into account both initiative and cause is apparent. Only with such data available, classified and calculated according to uniform methods, can progress be made in attacking the causes of high labor turnover and correcting them to reduce business losses. While almost every company has records of accessions and separations, this mass of data has been practically useless because uniform definitions and methods of calculation have been lacking.

For instance, to classify separations into three groups, own accord, discharge, and lay-off, is entirely inadequate. A death can hardly be called an act of one's own accord, a discharge, or a lay-off. The same difficulty exists as to pensioners, who will not quit and cannot be discharged. If an employee is recorded merely as leaving of his own accord, his employer does not know the cause. Most workers leave for a better job, or because of some disagreement with a foreman or supervisor. An employment manager should be vitally interested in the details of all such cases. If workers are leaving for better jobs, it is time for the company to begin studying its wage rates, its working conditions, and any other factors which may, figuratively, give it a black eye in the community, and worse still, among its customers. If disputes are arising throughout the plant between workers and foremen, some harsh and unreasonable department heads may be wrecking the morale of the organization by their methods. Such men must be curbed or removed.

In cases of discharge, records are usually accurate, because the employer takes the initiative and knows the cause. A narrow margin separates discharges and voluntary quits from the worker's own accord, however, because often a worker knows he is about to be discharged and leaves of his own volition. Discharges vary with the state of the labor market, being large during slack times when the employer can pick and choose his workers and get rid of those who are least desirable. Suspensions, which may be termed temporary discharges, have no place in labor turnover statistics, because they are merely disciplinary measures.

In lay-off, the employer takes the initiative. Slack work, breakdowns of equipment, lack of materials, and similar causes are the occasions for lay-offs. Some employers seek to eliminate lay-offs from labor turnover statistics, but there is no justification for this attitude. If such statistics are to be of any value, they must be comprehensive, fix responsibility, and apportion blame. Lay-offs are often occasioned through poor management, and it is well to show such conditions up. Moreover, lay-offs indicate managerial responsibility for labor turnover, and to that extent are of real value in the statistics.

The lay-off occupies a position midway between a worker leaving of his own accord and the discharge. When the worker sees no reason to quit, and when the employer has no reason to discharge him, he is laid off. Sometimes a soft-hearted employer lays off a worker when he does not want to inflict the stigma of a discharge upon him. But the wise employer will record the real, and not the supposed, cause.

The types of voluntary separation listed under the classification "Unavoidable," require no extended explanations. The position which "Transfers" should occupy in labor turnover has not yet been clearly established, except in a few highly organized companies. Their inclusion is a refinement, varying in importance, with the size of the company, difficulty or danger of the occupation, etc. Transfers concern only a small percentage of the average number of employees per year, and show the management whether the employment department is doing a good job in shifting employees from one position to another. They are of much greater importance from the departmental than from the company labor turnover standpoint.

When labor turnover figures are compiled for an

Analysis of Turnover Data by Type of Industry

Industry	(1) Accessions		(2) Voluntary Quits		(3) Discharges		(4) Lay-Offs		(5) Unavoidable		Total Separations		(6) Average No. of Employees	
	No.	%	No	%	No	%	No	%	No	%	No.	%	No.	%
Clothing														
Electrical Equipment														
Food, Beverages and Confectionery														
Foundries and Machine Shops														
Instruments and Photographic														
Lithographic and Printing														
Paper Boxes														
Shoes and Leather														
Woodworking and Furniture														
Textile														
Public Utilities														
All Others														
Total														
Rate per 100 Employees														

Rate per 100 Employees

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	12 Mo. Avg. Past	12 Mo. Avg. Future
Accessions														
Separations														

Rochester industries use a form like the above to compile statistics on labor turnover in the district

individual department, then the transfers into and out of that department should be called accessions or separations. Likewise, when turnover figures are inter-plant, then the transfers from one plant to another plant of the same company should be called separations from the first plant and accessions to the second. Where a concern is expressing labor turnover figures for its company as a whole, transfer figures should not enter into its turnover data, as the employee is still on the company's active records.

There may be causes other than those listed, for separation of employees from a concern, or the causes may be broken down at times into finer details. For minimum requirements, however, or for general purposes, the present list seems adequate. The fact that labor turnover is a symptom of sources of loss other than the mere leaving of an employee, renders it advisable to treat each separation as an individual problem, and to ascertain if the causes involved can be rectified. Some analytical work must be done in each case by the personnel director, or by someone in close touch with the working force and management. A large percentage of companies now interview their employees before allowing them to leave, and thereby get somewhere near the real source of dissatisfaction.

With data collected under the various headings outlined in Table 1, a very valuable trend line can be built up. Comparisons of the trend of employment in each local community, and between communities, are valuable for weighing the various factors connected with personnel administration. A still more directly useful comparison is that between industries engaged in the same type of manufacturing. Such comparisons eliminate unrelated kinds of occupation, and include only those where the nature of the work is similar.

The time would seem ripe for some division of the Department of Commerce, or the United States Chamber of Commerce, to establish a joint committee on labor turnover, composed of members from various management organizations. This committee could serve the dual purpose of formulating definitions, mathematical formulas and graphical methods for the presentation of labor turnover statistics, and of functioning as a tribunal to consider cases and to render interpretations under the definitions and formulas suggested. Accomplishment of the first objective would establish uniformity and standardization of labor turnover data. Realization of the second objective would cause the standard method of collecting and compiling labor turnover statistics to become generally used throughout all industry.

No one knows how much loss American industry is suffering annually through labor turnover. A large item of the direct loss is that involved in training new employees to take the place of those who leave. In most plants this expense varies probably from $50 to $200. The indirect loss has never been measured and many of its causes are not apparent. The total avoidable waste involved, however, is so great that methods to reduce it are well worth while.

The British Air Ministry has issued a notice to airmen that the terms port and starboard shall not be used in connection with private or commercial aircraft, using "left" and "right" instead. The United States Navy officially adopted the terms left and right several years ago, although the terms still cling, as do most old practices.

Close Tolerances—*Discussion*

By J. Gurwitch

REFERRING to Mr. Godfrey's article on tolerances, on page 365, Vol. 70, I agree that close tolerances do not always tell the full story of the accuracy of a product. After all, the question of tolerances hinges on the judgment of the designer and of the man who is responsible for production. Needless to say, the determination of permissible errors or variations is not a simple matter, but calls for the exercise of unusual discrimination and good judgment. The designer, especially when freed from responsibility for costs, will endeavor to have these variations as small as possible. He will insist on a close approximation to the ideal. On the other hand, the man who is responsible for production will reason that the time and cost of manufacturing under certain conditions will increase with the degree of accuracy required; and he will naturally seek to obtain the largest tolerances possible.

Should the situation be dominated by either of these views, trouble is likely to ensue. The unrestricted designer usually demands unnecessarily high standards. The unrestricted production man usually tends too strongly in the opposite direction. The best course lies between the two extremes; hence the necessity for someone to apply good sense in the selection of working standards. The best compromise to be had is when the standards are selected by a well balanced committee on which engineering, production, and inspection are represented. If determined in this manner, too close and impracticable tolerances will be avoided.

Handling Trade Papers in the Shop

By G. B. Stuart

READING trade papers in the big industrial plant where the executive has a scheduled day that does not leave much time for details has been put on a production basis. At one plant the magazines subscribed for by the company go first to the advertising manager's office. These papers average about 40 individual copies a week, and are gone through carefully by a secretary who marks with a tab any pages in either the editorial or advertising sections containing material of interest to the company. This material will include the company's or competitor's advertising, or articles, new tools, and patents closely allied to the work of the company.

Every magazine having such tabs is then put on the desk of the manager, who glances through the designated material each day, and then passes the paper along after taking such action as he desires. The magazines are then routed out to the departments and men to which the particular trade paper should be of most interest.

At another plant, a large electrical company, the trade papers all go first to the plant librarian who attaches to the cover a route card containing the names of department heads, supervisors, and foremen who have previously asked to have the particular paper come to them. One weekly, for example, was routed to 15 men in the plant, and two copies were required so that it could be passed along to everyone on the list within a reasonable time. A maximum of one day's time was allowed to each reader. After circulating, the magazines are placed in the library for general shop use.

A Change in Materials That Returned Over 200 Per Cent

Unpainted hoist, showing aluminum parts

IT IS sometimes better business to use the more expensive material, when there is a choice, even though there is a wide spread in cost between those under consideration. A case in point is the coal truck illustrated. It cost an extra $645 to use aluminum for the body and some parts of the hoist, but the return on this extra investment was 206 per cent.

The reason lies in the fact that the Pennsylvania highway laws permit only 22,000 lb. to be carried under the "W" license. The tare weight of the chassis and steel body would have been 11,860 lb., leaving 10,140 lb. of capacity for pay load. The lighter but more expensive aluminum body and other parts weighed 1,800 lb. less, thus increasing the permissible pay load to 11,940 lb., or by 17.7 per cent.

Photographs by courtesy of the Aluminum Company of America

Completed truck with aluminum body elevated

Cash or Royalty on Machines?

JOE THOMPSON had built up a successful practice as a consulting engineer and designer. His latest job was for a new client, the Baker Machine Company, and he had just completed and delivered to Mr. Baker, the president, a set of drawings for a new type of machine. The method of payment which he was being urged to accept was different from any he had ever been offered. Before agreeing to it he decided to call on his good friend, Bill Holland, to talk the matter over. Much to his surprise he found Mr. Baker in the office when he arrived.

"Well, Mr. Baker," said Thompson, "as long as we're both here we might as well lay all our cards on the table, face up, because I imagine we have come on the same errand."

"All right, Joe. I guess that's the best way. Shall I start it?"

"Guess you better, Mr. Baker. I can check up if it doesn't agree with my notion."

"Joe, here, has designed us a new machine, Bill, and I want to say right now, it's a peach. He sure had a stroke of genius the day he laid that out, for it does all we asked for, and a lot more. It will cut the machining time in half, at least."

"You're generous with praise, anyhow, Baker," said Holland. "Perhaps Joe thinks you want to pay the bill that way."

"Not exactly, Holland. We realize that it's a good machine and we want to pay a fair price. The fact is, however, that we are not very flush with ready cash just now. We've had a heavy drain on the treasury, of late, and the balance isn't anything to brag about. So, instead of paying Joe a lump sum, I'm proposing a royalty on the use of the machine."

"The truth is, Mr. Holland," said Joe, "I'm a bit scared at what looks like a gamble to me. I know the machine will work, and save Mr. Baker a lot of money. But I need some money now. How do I know that he won't get someone else to design another machine on the same basis, and put mine out of commission before I've had a fair return on it? Did you ever know of anyone paying for machines that way, Mr. Holland?"

"Yes, Joe, it's an old method, and it has advantages. George Corliss sold his steam engines on the basis of fuel saved over a given period. Some prefer to take work on the basis of savings. But, of course, there must be provisions to safeguard both sides in any contracts made on a basis of this kind.

"It would seem in this case that Baker might make a first payment in cash, to help Joe stand in with his grocer. If he then pays Joe so much a piece, or a hundred, for the work done on the machine for a year, or two, or three, it ought to work out well for both."

"But how do I know he'll use it at all, Mr. Holland?"

"That's where the safety provision comes in. All such cases have a minimum return stated, either in years or money. It ought not to be hard to agree on something of the sort. When you both want to play fair, I don't believe either of you need to worry about the exact details. If this machine saves money, Joe can probably make others that will be valuable later on. Then you'll both benefit by keeping on good terms."

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Discussion

Archaic Accounting

"There are two ways of making money, one at the expense of others, the other by service to others." These are the sentiments of Henry Ford. I feel that Alfred Robinson, talking under "Archaic Accounting," would be a happier man today, and just as much in pocket, had he conducted his business with old man Black under the second method, instead of under the first.

So many of us, even today, think the Golden Rule a fallacy, and believe we are showing

Idea Submitted by Donald A. Hampson

more business acumen by saying, "That's his funeral, not mine." "Am I my brother's keeper" is just as pertinent a question today as it was the first time it was uttered. Possibly the old man was old-fashioned in his cost accounting, but why couldn't Robinson see or appreciate the innate honesty of the old man in his appeal for a higher rate. There certainly was no question of charity involved, since it was admitted that the work in question was good value at three times the price. I agree with Holland that he should have met him on a fifty-fifty basis. The fact that he tried to look sympathetic may be business; but I have heard it defined in much different language.

—JOHN WILKINSON.

How Much Interchangeability?

With the advent of mass production, scale and caliper measurements and the plug and collar gages have given way to machine gaging of work. It is far easier for the machine operator of today to produce interchangeable parts within close tolerances, than it was for the skilled mechanic of thirty years ago. Grinding offers a low-cost method of meeting exact dimensions.

In spite of precautions, rejects may pile up, due to lack of measuring attachments on the machines, poor condition of machine tools, faulty workmanship, and similar causes. Half of these rejects can probably be reclaimed. The inspection department can sort the defective parts into bins. Those which go together, such as shafts and bushings or bearings, can be classified under new tolerances which will allow small shafts to fit in small bearings and large shafts into large bearings. Such parts should then be identified by stamping serial numbers on them, preceded by prefixes, such as A-1, A-2, A-3.

These parts can then be installed in the machines, since they fit together and will give no trouble in operation. When the customer needs replacement parts he can order them by number and prefix. Reference to the records maintained will enable the manufacturer to furnish a replacement part which will fit in the machine in question.

Operators on lathes, milling machines and grinders should be encouraged to own and use micrometers for close control of dimensions of work. Go and not-go gages, generously distributed throughout manufacturing and inspection departments, will do much to cut down rejects and hold the parts within the range of interchangeability.

—R. L. HASELGROVE, *England.*

Finish on Machines

Three years ago our shop bought a new lot of machine tools, well finished and painted gray and black. I told our men that we stood at the beginning of a new period in our workshop. Henceforth, we would have not only the best machines and small tools, but also the highest grade of craftsmanship, and every man must take care of his own machine and tools. The men responded enthusiastically to this stimulus, saying there would be no difficulty in doing the best work on such fine-looking machine tools.

Of course, well-finished machines alone are not sufficient to assure high grade work, but they account for a substantial percentage of the good results secured. The machines in our shop are in the best of condition, and every man is proud of the fact that his machine still looks as though it had been installed only a week. Poorly-finished machines have exactly the opposite effect. Nobody wishes to work on them and the quality of product turned out reflects a careless attitude.

Mr. Holland is right; the expense of selling a machine with a second-rate appearance is greater than the cost of putting on a good finish. The banker likes to sit at a rosewood desk, and has a right to do so, but he should realize that the man in the shop, rough though he may sometimes seem, has a keen appreciation of good-looking machine tools, and responds with high quality work.

—FRANZ BERMANN, *Austria.*

Should a Buyer Specify Design or Results?

A buyer should specify results. But let us consider what results are. The measures applied include: production per hour, hours of production, maintenance, and accessibility.

Production per hour is, of course, the most important point to consider, but this is only a matter of figuring cutting feet per minute and feed per revolution.

I have charge of six semi-automatic machines, two machines to an operator. Each machine has 21 oil glasses, grease cups, holes and pipes, and two places where plates, fitted with knurled nuts, must be removed to oil a worm. It takes an operator 20 minutes to oil up. Each machine produces 200 pieces per hour. Six machines, each down 20 minutes, mean a loss in production time of 120 minutes or two hours, which at 200 pieces per hour cuts output 400, a 3½ per cent loss each day.

"You never had much trouble with our machines," and "Not as much trouble as with others," are excuses that will not do. When Mr. Barrows can correct a fault, he should do so.

There is also a time element in operation to be considered, such as reaching for starting and feed-engaging levers, which most machine builders lose sight of. The matter of strength, wearing surfaces and bearings should be left to the builder, but the matter of speeds, feeds, oiling systems and accessibility should be as the buyer may specify.

—W. E. FISCHER.

Design and Construction of Large Airplane Tanks

Photographs by courtesy of the Glenn L. Martin Company.

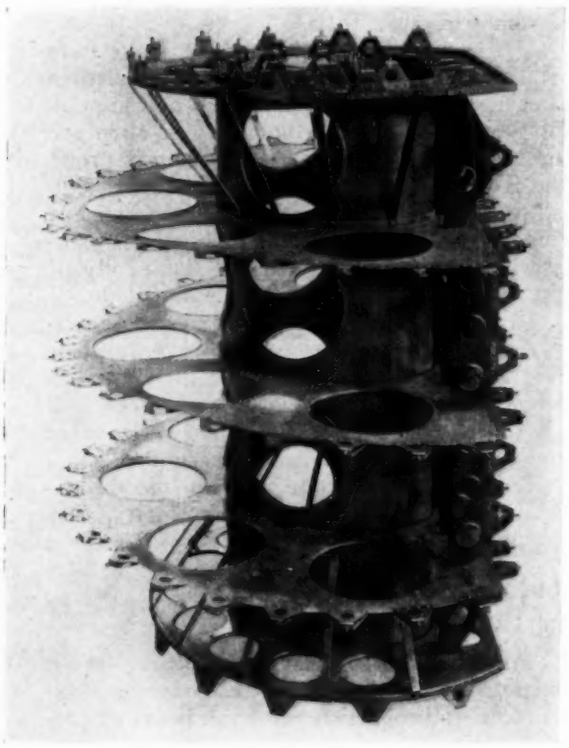

Fig. 1—Interior baffle of main fuel tank of T4M-1 plane

LEAKING fuel tanks are an ever-present source of danger in an airplane. The fact that a small leakage will permit complete evaporation of fuel and cannot be detected, adds to the importance of prevention.

The constantly increasing size of main fuel tanks demands a construction that will not only withstand continuous vibration, but that will also stand up under the hammer blows caused by bumping over the landing field, and minimize the surges due to a change in direction of flight.

Fluid, flowing from a tank on one side of the ship to one on the other side, through a connecting pipe is a recognized method of minimizing the rolling of a ship, and the momentum of a large quantity of fuel, unrestrained, would affect the maneuvering qualities of a plane materially.

Having these factors in mind the Glenn L. Martin Company design their fuel tanks with internal baffles that not only minimize the surges, but also act as strengthening members. To save weight the cylindrical part and webs are made of Duralumin, but the connecting clips are of steel tinned with the screws in place, the threads being protected during the process by suitable handling fixtures. A baffle is shown in Fig. 1 with the connecting clips and screws in place.

The outer shell is made of a coated steel that takes solder readily, it is assembled over the baffle as shown in Figs. 2 and 3. Over each screw is placed a star-patch designed to prevent vibration concentrating at the point where the screw penetrates the shell. An oversize 10-32 nut holds this down, and the whole is securely soldered to the shell.

Before any new design is accepted or any change made, representative tanks full of water are vibrated to destruction in a machine built for that purpose. No tank that will not withstand a 50-hour test of severe vibration is passed.

Fuel tanks are placed or built in whatever space that the balance of the plane permits, usually the main tanks are in the fuselage, with an auxiliary tank in the wing to give gravity feed to the motor. If possible, they are placed so that leakage due to gun fire cannot be ignited by the motor exhaust.

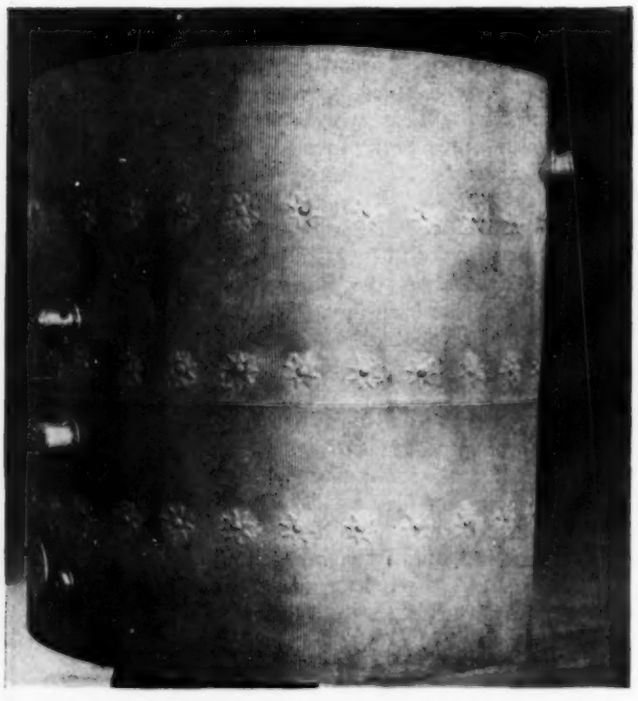

Fig. 2—Bottom view of completed tank

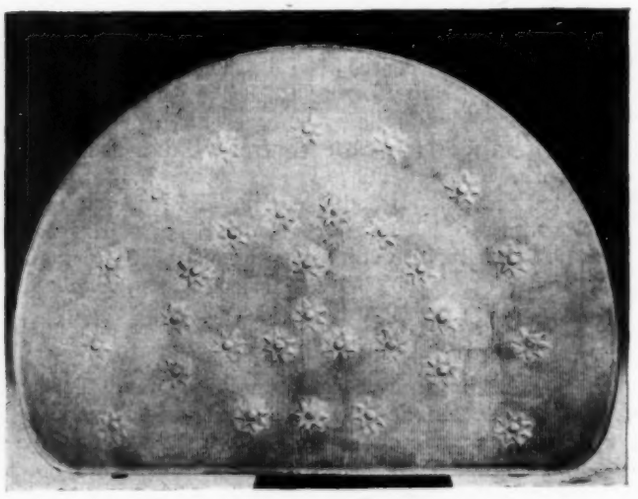

Fig. 3—End view showing star patches and staybolts necessary to stay ends against surges

The Depreciation Account

By Ernest F. DuBrul

Fellow of the Institute of Management,
General Manager, National Machine Tool Builders' Association

Shall it tell merely a bedtime story of something that happened "once upon a time," or shall it tell something that the executive has to know?

THERE is much argument in accounting and engineering circles in connection with this thing called depreciation. Many writers and speakers are discussing the point as to whether depreciation should be taken from present reproduction cost, or from cost of acquisition. Some distinguished professors of accounting and eminent partners of important accounting firms show confused thought and expression on this subject. This confusion has such an important reflex action on business that there is need to worry about it. Some so-called principles of accounting are enunciated by writers whose confused thoughts are offered as guides to be followed by business managers. Then various business men in a given industry try to follow different guides and the industry's situation is sure to be hurt.

For instance, one professor says: "It should first be stated that many of the disputes about the content of overhead arise from confusing the economic with the accounting definitions of cost." A partner of a large accounting firm says that it will not do to mix accounting with economics. This thought is repeated in various forms by other writers. But the sensible business man understands that economics is simply the science of business principles, under a schoolbook name. The business man as such is engaged solely in practicing the economics that the economist writes about.

Essentially, the function of accounting in the business structure is to give the business man certain business or economic information. Therefore, in spite of the ideas of accountants and professors of accounting, the accounting function is a part of the economic structure; accounting is a part of economics, and its methods can and should be squared with economic facts.

Dr. E. A. Saliers, in his book on "Depreciation—Principles and Application," says:

> Viewed from the financial side, capital invested in plant has two aspects, cost and value. Accounting deals with cost rather than value.
>
> Practically all accounting for wealth invested in fixed assets is on a cost basis and bears no relation to present exchange value or to replacement cost.
>
> Depreciation from the accounting point of view deals strictly with the replacement of wasting assets at actual cost to the plant.

Now the business man has to deal both with cost and value. If his accounting department is to deal with only one of these essential aspects, then he must establish some other staff, separate from his present accounting staff, that will deal with values.

Any thoughtful manager will say that this alternative is ridiculous. There is no reason why the same accounting staff should not deal with both cost and values. It is purely an accounting tradition, based on confused thought, that seeks to confine depreciation accounting solely to the cost basis.

In a large number of cases, the value aspect is the much more important side of the problem. Why expect the business man to have one staff of accountants dealing solely with cost; another staff of super-accountants dealing solely with value; and the executive as a super-super-accountant, co-ordinating the two?

Since values of fixed assets have a habit of changing, original costs seldom correspond with values for very long after assets are bought. Costs are historical and static, whereas values are current and dynamic. A record of the number of dollars paid for an asset is simply a bedtime story of what happened "once upon a time." But a material change in the current value of that asset is a current fact of extreme importance to the executive.

> Business men need something more than they have been getting in the way of accounting service. They need something better to guide their policy as to replacement to make sure that they have not omitted a very essential element of depreciation in their cost sheets, that they have charged on these cost sheets the amount that they must collect from customers if plant is to be replaced

When he sets up his depreciation account an accountant is trying to do something; so it is worth while examining the ideas that "conservative" accountants express concerning the thing they are trying to do. Dr. Saliers points out that,

> No enterprise can continue to prosper unless the substance of its wealth is preserved and at the same time made to produce additional wealth. This necessitates the adopting of accounting procedure adequate to separate capital from income.

He also says:

> The business man cannot neglect these costs of production which occur in the form of depreciation without incurring damaging results. They are intimately connected with the policy of making repairs and replacements, of making betterments and extensions, and also directly with that of price fixing and general financial control.

From these quotations it is evident that actual replacement of physical assets must have a lot to do in the accountant's mind with the setting up of a depreciation account.

In another place Dr. Saliers says:

> The word "depreciation" refers to the financial effect produced by deterioration, wear and tear, obsolescence and inadequacy.

And in another place in his book he says:

> Depreciation is used in its most comprehensive sense as including all forms of deterioration of wealth. * * * It is impossible to enumerate all the special causes of depreciation. Generally they are classified under the three heads, Wear and Tear, Obsolescence, and Inadequacy; but this is merely a general statement, and in reality the specific causes of depreciation are numerous.

So it is evident that the accountant is trying to measure in dollars a financial effect that is produced by some causes, having in mind that this effect has some close connection with replacements of physical assets, and not the mere writing down of figures on books. Otherwise, references to the preservation of the substance of the wealth of an enterprise, replacement of wasting assets, and the intimate connection between depreciation costs and the policy of making replacements would not occur to the writer of the book from which these quotations are taken.

But there are some other financial effects as intimately connected with the same assets, which also are intimately concerned with the replacement of assets when they are worn out, or are obsolete or inadequate. If depreciation, "from the accounting point of view deals strictly with the replacement of wasting assets at cost," what will accounting give us to deal with the replacement of the same assets when we must pay more or less for them than they cost when originally installed? That is the financial problem that must be solved by the executive, and its successful solution is at least as intimately connected with his price policy as is depreciation, if taken merely from the cost of the asset.

If prices of commodities were stable, if a building built in 1896 could have been replaced in 1920 for the same amount of money, accounting for original costs would automatically account for values. But, unfortunately, all price index curves going back to 1812 and coming up to 1929 show very wide fluctuations in prices of commodities; or, conversely, in the purchasing power of the dollar. These fluctuations inject into the business man's problem certain dollar facts that some accountant seem to insist must not be dealt with by the accountant.

Then, when some one else wants to put these dollar facts before the executive, the accountant says he is "mixing economics with accounting." Yet the very quotations above cited from one of the leading writers on the subject of depreciation show that in the matter of replacement of this physical capital, which is losing utility either through wear and tear, obsolescence, or inadequacy, the business man must mix some kind of accounting with economics if he is to be able to guide his policy; whether that accounting is conservative or some other kind.

This fluctuation in purchasing power has always been a factor in the executive's financial and economic problem, but conservative accounting does not yet recognize the problem with which progressive accounting is successfully dealing.

Progressive accounting does not ask business men to set up another set of books to be operated by a different staff alongside of the conservatives. It is much more practical to employ a progressive accountant who is able to keep value accounts as well as original cost accounts, and who makes accounting entries that tell the truth, the whole truth, and nothing but the truth, both as to costs and values.

Current expenditures for labor and material and all out-of-pocket overheads are of course made in dollars of current purchasing power, and they are so recorded as a matter of every-day routine, without any more thought on the part of the progressive accountant than is given to them by the conservative. The current purchase price of materials and labor generally serves very well as a unit in which to measure the cost of items that pass through a plant relatively quickly.

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But this is not always the case even for working inventories. When prices rose very rapidly between 1916 and 1920, and then fell very rapidly in 1921, both these rapid price movements created some very serious financial effects that should be shown in accounts, the downward movement of 1921 being quite the reverse of that of the previous three or four years. Even conservative accounting takes cognizance of these effects when prices fall. This is not done as a matter of principle by most accountants, but purely because some men, without giving it very much thought, call it "conservative" accounting.

Conservative accounting says that inventories should be valued at cost or market, whichever is the lower. Therefore, if the prices of materials on hand have fallen during their period of retention in the plant, conservative accountants abandon the cost principle and go over to the value principle. Conservative accountants dimly see that the marked financial effect of falling inventory prices ought to be reflected in their accounts. But they seem to be unable to recognize the financial effects of rising prices, even on inventories.

Those who believe in accounting for values, as well as accounting for original costs, insist that owners and executives should have both cost and value facts in all cases. They see no logic in recording only the less important fact of original cost during periods of rising price, and excluding from the record the more important fact of increased values in such periods. Nor do the progressive accountants lose sight of less important facts

of original cost when prices are falling and record at those times only the more important facts of present values. They believe in showing both facts at all times, and for all kinds of assets, whether current or fixed.

Progressive accountants believe that books should show the loss of value of fixed assets, which were acquired at times of high prices, when they lose value in times of falling prices, just as they should show similar losses in inventory values. They believe that it is important to show both costs and actual values for all assets in times of rising prices as well as in times of falling prices. Conservative accounting is simply not consistent with itself, but progressive accounting is thoroughly consistent because it insists that all facts should be shown at all times, and none should be covered up.

As to the relative worth of the two methods to the owner and executive, certainly that accounting method is best which gives the executive information on which he can best base a sound business policy. To succeed, his policy must square with current facts. He cannot get current facts from conservative accounting. Judging by results, the executive can well say that conservative accounting does not give him some very necessary facts that progressive accounting does. Leading accountants say that accounting must deal only with facts, but in the next breath they insist that accounting must not deal with value facts. They shut their eyes to the cold fact that, as Dr. Saliers says in his book, "Viewed from the financial side, capital invested in plant has two aspects, cost and value." They strongly criticize those who insist on dealing with both sets of facts as they relate to plant assets, as well as to current assets.

Progressive accountants believe that books should show the loss of value of fixed assets, which were acquired at times of high prices, when they lose value in times of falling prices, just as they should show similar losses in inventory values. They believe that it is important to show both costs and actual values for all assets in times of rising prices as well as in those times when prices fall

A good illustration of the distinction between the financial effects of the changing purchasing power of money and the physical effects of deterioration came to my notice recently. A company had two return-tubular boilers, 72 in. in diameter, and 18 ft. long. These boilers were installed in 1908. Due to a bad water condition, the boilers deteriorated in twenty years so that they were condemned by the boiler inspector and ordered replaced in 1928. Here is a clear case of complete physical deterioration. The scrap value of the boilers taken out did not equal the cost of taking them out. So there was also a complete loss of value.

The company in question had estimated a life of twenty years for these boilers, so that from the engineering side their estimate was close to the physical facts. The company's accountant had reserved and charged the cost of product 5 per cent of the original cost of those boilers each year, so that according to all the canons of conservative accounting, the company's "capital" was intact.

But the dollar's habit of changing in purchasing power injected another financial condition into the executive's problem. The original boilers had cost $2,800, in place. Two exact duplicates twenty years afterwards cost $6,800. When the company paid the bill for the new boilers, the accountant set up $6,800 in his boiler account, and took $2,800 out of his depreciation reserve.

By all the traditions of conservative accounting, that company had $4,000 of surplus on the books, and yet it had no more boiler property than it had originally. It is quite obvious that the only surplus existing anywhere was a mere figure on the accountant's book. This $4,000 was a profit only in the eyes of the accountant. From the point of view of the economist or the business man, it was an actual cost that had not been charged to cost during the life of the boilers.

That accountant followed Dr. Saliers, who comments as follows:

> Accounting deals with cost rather than value, and replacement allowances are made on the basis of cost of the unit to be replaced, not on the basis of its exchange value or on the cost of replacement.

But this policy is not reconcilable with the two following statements of the same author, who says:

> When depreciation costs are not included, spendthrift consumption is encouraged because costs are understated and profits overstated.
>
> Ordinarily the capitalization of depreciation arising out of wear and tear is erroneous, for this results in meeting its cost through issuance of new securities, a mistake not infrequently made.

Certainly in the above illustration, the financial effect of this deterioration was not reflected in the accounts which were kept on the cost of acquisition basis. If the company had paid out this accounting surplus in dividends, it would have had to meet the additional cost of replacement through issuance of new securities, which Dr. Saliers points out to be a mistake.

Another example of the confused thought expressed by Dr. Saliers occurs in the following discussion of unit depreciation:

> Machines embody in themselves utility created by their manufacturers. By use, this is exhausted and becomes an element of cost of the commodities it produces. Thus in the words of Leake, the capital outlay of the machine expires, and to avoid a continuous expiration of capital outlay on the entire plant, the machines, rolling stock, power producing and distributing systems, etc., which comprise plant, must be replaced when they become ineffective. When a machine which has been transferring its utility into commodities for twenty years collapses, it should not be replaced from current revenue, unless replacements of such kind are scattered evenly enough over monthly intervals, as not to make such replacements an undue burden upon the current month.

In this paragraph, when Dr. Saliers accepts Leake's conception of depreciation as expiration of capital outlay, he mentally confuses the physical fact of deterioration with the financial effect which his depreciation account is trying to picture. It is the utility that expired, but the financial effect of this expiration may be either greater or less than the money outlay that was paid for the utility.

If boilers had been bought at the peak of the price

movement that occurred in 1864, and were replaced because worn out, at the very bottom of the price decline that ended in 1896, the capital outlay for their replacement would have been only about one-third of the original outlay. Assuming that funds had been set aside each year for 32 years, which at compound interest exactly equalled the original cost, the company would have had much more money on hand than would be necessary to pay for the replacement. Yet the books would not show this to be surplus money, if depreciation were figured on the basis of original cost.

Charging this excess to cost would have deceived the executive as to the true depreciation element in his cost of production for the whole 32 years. The books would have been actually understating his real money profit and overstating his cost. They would have reflected in costs much more than the financial effect of the loss of utility that the boilers had been transferring to the goods produced in this period.

If, then, the new boilers were treated in the very same way from 1896 to 1920 the books would have deceived the executive in exactly the opposite fashion. They would have shown a surplus profit where no surplus of property existed. They would have deceived him into believing that he had a lower cost of production than that of a competitor who had bought the very same sort of boilers some years later at a higher price.

Because of these changes in the purchasing power of money, it is necessary to set out both the cost and value aspects which Dr. Saliers recognizes to exist in capital invested when viewed from the financial side. Only in this way can the executive get a complete picture of the business facts that he must wrestle with. Why should his accountant try to deprive him of this very important picture by insisting that accounting for fixed property should deal only with cost facts, to the neglect of value facts? And when accountants do only that, how can they say that their replacement allowances are intended to provide funds with which to replace the equipment? Are they not merely providing funds to equal the original outlay, and neglecting entirely the more important thing of getting the money needed to replace the property?

Necessity of Value Accounts

To bring out a vivid illustration of the necessity of using value accounts rather than cost of acquisition, one need only consider the situation in which the executive of a German or French business house found himself during the worst periods of currency inflation in those countries. During that inflation period, what good would it have done a German executive to figure depreciation on the original cost of assets, acquired when marks were worth four to the dollar? At the height of the inflation, the German mark had depreciated to such a point that it took the fantastic sum of 250 billion marks to equal the purchasing power of an American dollar.

In France the legal franc has now only about one-sixth of the gold value of the old franc, yet both are called by the same name. Even though the old franc itself had not lost any of its pre-war purchasing power, how can accounting for original costs in pre-war francs help the French Executive when the present-day franc has only one-twelfth of the purchasing power of the pre-war franc?

The inflation of these two currencies produced financial effects on German and French business concerns that did not differ at all in principle from the financial effects produced by the changing purchasing power of the dollar on American concerns. The only difference was in the greater degree of need in accounting for the effects produced.

Even conservative accounting would be horrified at a shortage of 50 per cent in the bank account. Why, then, neglect the business fact that at least 50 per cent real loss in the depreciation account has occurred since 1913 because prices of industrial equipment, buildings, etc., are at least 100 per cent higher than pre-war?

Do not these illustrations, taken from actual business experience, demonstrate that business men need something more than they have been getting in the way of accounting service? Do they not show that executives need something better to guide their policy as to replacement, to make sure that they have not omitted a very essential element of depreciation in their cost sheets, that they have charged on these cost sheets the amount that they must collect from their customers if their plant is to be replaced?

Adapting Ideas from Other Industries

By Charles F. Henry

IT IS difficult to realize how methods that are common practice in some industries are unknown in others. Or, if known at all, are so misunderstood that they do not seem applicable in one's own line of work. A recent case of this kind came up in talking to a railroad shop man about honing as a means of finishing bushings for locomotive valve motion work. He promptly assured me that no such refinement was necessary in finishing valve motion bushings; grinding was plenty good enough, and that honing or lapping would be entirely too expensive to be considered for a job of that kind.

Not being at all familiar with automobile shop practice, he did not know that honing had been developed into a very economical production method and that, instead of being an expensive refinement, it was now a common method of finishing cylinder bores and other holes, some much smaller than those found in locomotive valve motion work. Honing meant "lapping" to him, with lead or wooden laps and very fine abrasive, and with a slow, hand-fed job. He did not know that modern honing, as applied to automobile cylinders, produced very accurate holes and with an excellent finish, in about one minute per hole, when the proper amount of metal was left for finish by the hone, or grinding head.

There are many other cases that are similar to this. That is one reason a good consulting engineer, who does work for a variety of industries, is a valuable man to employ. That is why he should be much better than one of your own men, and why he can command a high rate for his services. His experience is not confined to any one industry. He sees similar problems solved in very different ways by men in entirely different kinds of shops. This gives him an advantage that no one whose activities are confined to a single line can possess.

There is also another point in favor of the engineer who gets into and studies varied industries. He can usually see how methods or processes can be altered or adapted to fit conditions existing in various industries. All too frequently the man who is entirely absorbed in one industry does not see the possibility of adaptation nearly so readily. Men of this kind usually must see the method actually applied to their particular problem and in this way miss many suggestions published in technical journals that might be applied to their work.

Notes from Southern Shops

By George S. Brady
Associate Editor, American Machinist

Many contract machine shops and machinery building plants have started within the last few years, and progressive methods and modern equipment are keynotes

UP TO a very recent period, which can be reckoned almost in months rather than in years, the South was not considered to any extent as a mechanical area. But the influx of textile mills, and a development of mineral resources after the War, were bound to have an effect. Everywhere one goes now in the South with his mechanical eye open, he is aware of a growing metal-working industry. The fact is also apparent that "Yankee" ingenuity is not confined to one section of the country, as the new shops springing up in this territory are not copying entirely from the North, but are showing great originality in methods, design, and in the handling of their personnel matters and management.

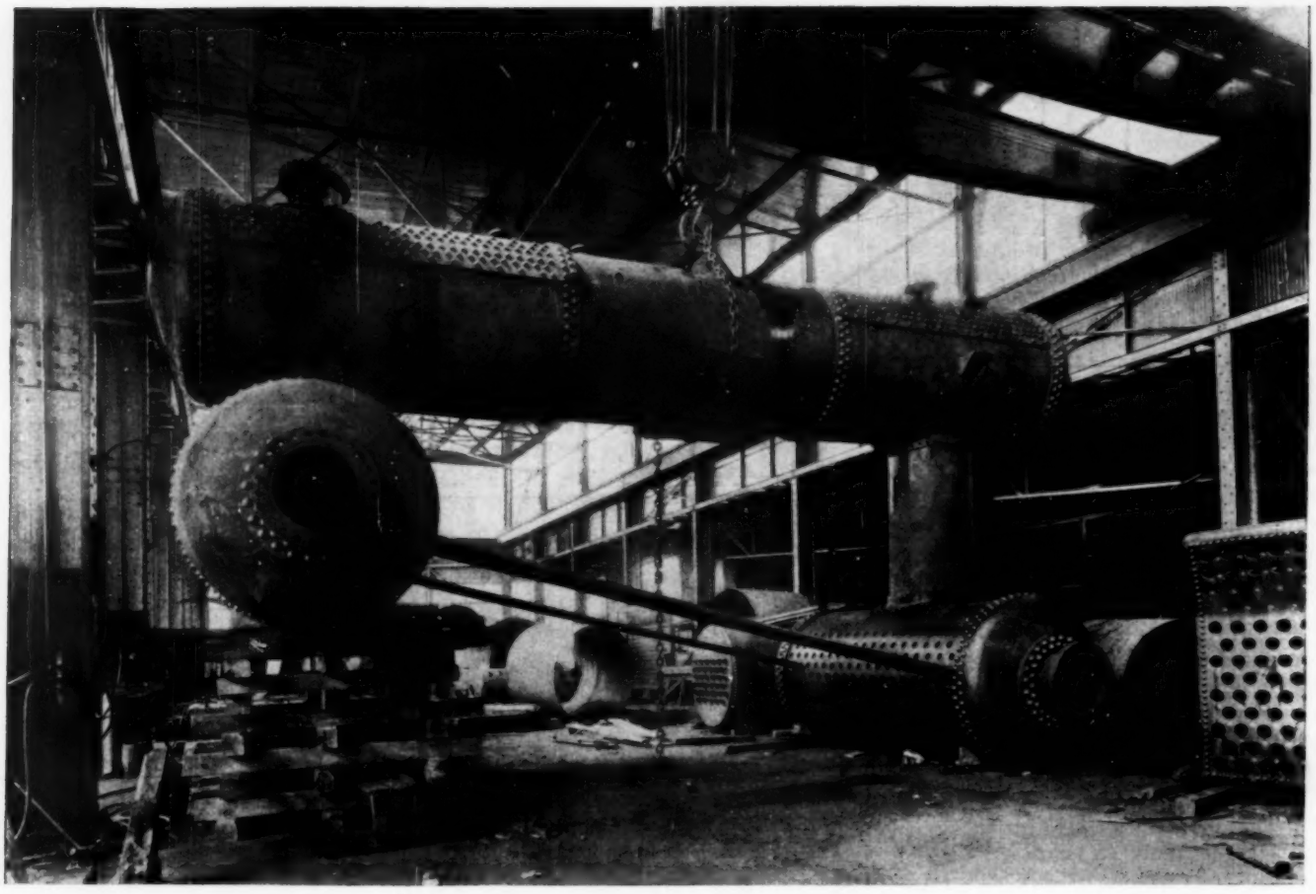
In a small town in the Tennessee mountains, where a group of industries have sprung up with a background of available raw products and plentiful native mountain labor, a local machine shop was started with the idea of making repair parts and special machinery for these mills. This is the section that produced remarkable men like President Andrew Johnson, and the people still make the classification of "learnin'" and "book learnin'." The manager of the shop was from the former school, and in his foundry he has done as fine a piece of research work as many laboratories that depend on book learnin'. The iron produced and used in the shop for cast machine parts has a fine even grain, machines easily and smoothly, and is quite free from blow holes. He obtains it by adding to the melt 20 per cent of old locomotive springs which he buys from a nearby railroad shop. The result is a uniform semi-steel low in sulphur and phosphorus, with a small percentage of chromium making an artificial Mayari iron, and enough vanadium to aid deoxidation and refine the grain. This mountain research engineer probably never heard of chromium or vanadium, but got his good castings by continually working for an ideal.

Right in the heart of the Carolina cotton mill region there is another shop which is making good in chasing an ideal. The owner of this shop saw the continuous trouble being experienced by the mills because of the cast-tooth iron gears in the cotton machinery being sent out of Northern factories that still treasure the traditions of the early designers of the textile machinery industry. He figured that this new generation of Southern mill owners would be glad to replace the cast gears by cut steel gears if he showed them how they could reduce noise and frequent delays from worn and broken iron gears. Three years ago he equipped a shop with modern gear cutters and started with one man. He has a bigger shop today with new equipment and 35 men, and is selling his cut gears in competition with the supply houses' replacement gears at four times their price. Someone has estimated that there are in use in Southern cotton mills a billion cast-iron bobbin gears alone, which can be replaced profitably with steel gears, and that the contract gear shops in the South can work to capacity until the Northern textile machinery builder learns to install modern gearing systems.

Speaking of textile machinery design, the North is likely to have to learn a lesson in the South, which if not learned quickly will cost it considerable money in the way of lost business. It is a well-known fact that the majority of mill installations in the depressed cotton centers of New England are made up of machines that are combinations of ingenious clever mechanisms strangely mixed with most primitive designs of vital mechanical elements that have not been changed in generations. It is almost unbelievable that designers of this class of machine will continue the practice of ignoring the advances made in bearings, gears, and in available materials. The clever mechanism design must necessarily be partly discounted by the progressive mill manager when he sees high-speed shafts running noisily in sloppy unbushed holes instead of in bronze bearings, and when he has to stop his machinery to replace uncut gears every 30 days. In every Southern mill center there are contract machine shops run by a new generation of progressive engineers who are pointing out these weak points to the mills, and in a number of cases textile machines are being built in these shops that are big improvements mechanically over the old lines.

These observations are based on a survey covering visits to eighty industrial plants in the Southeast. Enough is given to indicate that the new South is developing an individuality of its own as far as the metal-working industries are concerned

Contrasted with these design faults that the old machine builders have sent down from the North are some outstandingly progressive methods of service and distribution that have been installed in Southern industrial centers by Northern machinery builders. In Charlotte, as an example, one New England loom manufacturer has a manager with a distributing warehouse, and has 35 service men who travel throughout the southeastern textile district visiting installations of the company's machinery and seeing that the machines are giving service. For this regular maintenance service and advice no charge is made to the mill, it being figured as part of



View in a Southern boiler shop. The high-pressure oil still shown in erection is machined at all fitting parts

the sales expense and something comes back in experience.

Service in another way is given by a Southern builder of mill machines in Birmingham. This company will not sell one of its machines unless the buyer agrees to install it according to specifications or better. It does not want the adverse advertising that comes from improper installations, and is willing to send out its own shop men to make the installation at cost.

One of the railway shops in the far South has the practice of taking off the side rods and certain other parts every time an engine comes in for repair, and giving them a normalizing treatment in a furnace installed just outside the main shop. This seems to be a step ahead of the general practice in the larger shops of the country.

Another railroad shop in Tennessee has put in an installation for reworking the asbestos packing taken off of the locomotives that are dismantled for overhauling. The old packing is ground up thoroughly and mixed with water in a mixer. It is then compressed into lagging blocks in a special press having a 14-in. cylinder using air pressure at 90 lb. per sq.in. This same shop has its acetylene for welding, piped to various parts of the plant instead of using tanks. Terminals are located at various convenient points so that easy connections for welding can be made.

As a general rule, the railroad shops in the southeast have a cleaner appearance than many of the older Northern railway shops. This may be due partly to the fact that they are open during more months in the year, but there seems to be more to it than that. There is more fresh paint being used—and in at least two shops this paint was of bright colors. I dropped into one shop just after the workmen had quit for the day. The forge shop was "as clean as a whistle." There were none of the customary heaps of miscellaneous materials, machines had been wiped clean, and tools arranged in order. It is a requirement of the shop that the men clean up before quitting. This shop had more than the average amount of modern machine tools seen in railroad shops, and I wondered if there was not a connection between the two. Master mechanics in the North often complain that they cannot convince the higher railway executives who pass on purchases of the value of modern machines. Can it be that operating officials look down on the maintenance shop as the dirty end of the business where new machines would soon look like junk anyway?

Continuing from the subjects of noise and cleanliness in shops, here is one evolutionary development that may yet return North to a wider field of application than that in which it went down. Humidifiers have been used for many years in cotton mills to condition the air and keep the moisture in the factory atmosphere at an even balance for the proper working of the yarn. The Southern mill managers have noticed that the properly conditioned air also improves the health and efficiency of the workers, and at the present time it is estimated that there are 50 per cent more humidifiers installed in Southern mills than are actually needed for the requirements of the cotton. If it raises production to condition the air in cotton mills the same ought to be true of metal-working plants or any other kind of factory. In fact, one large office in a Carolina city has a humidifier installation with good effects.

As in all new developing countries, where the manufacturers have not settled down to standardized methods, the new shops in the South are doing things for efficiency regardless of how it was done before. One plant has the drafting boards lined along the windows in the draft-

ing room in the customary way, but has built light wooden partitions between the drafting boards. These partitions are open on the inside and are not high enough to shut off the light to the inside of the room, but they serve to place each man in a little office of his own where he can go ahead with his designs without the disturbances usual in an open drafting department.

Two different factories in Richmond furnish working uniforms to their employees. They are not metal-working plants, but the idea was recalled again in Alabama when it was noted in a steel mill, and again in a mine, that the employees were provided with facilities and required to wash thoroughly and change their clothes before going home to their families. What a contrast from the mad rush of unwashed humanity that can still be seen in many of the older industrial centers of the North when the five o'clock whistle blows! Bolshevism and Socialism always appeared to be linked up some way with uncleanliness, and undoubtedly when the Southern wife rejoices that her mechanical husband does not come home to wipe his cast-iron dust and oil over her day's cleaning she helps to create a social atmosphere where the germs of unrest and unfriendly relations do not breed. Anyway, these particular plants have found that their employees prefer to go home clean.

Down in Atlanta there is a plant that typifies the new industrial South. It is an electrical sub-station that represents an investment of $375,000, and is fitted with the last word in modern automatic equipment so that no employees of any kind are required. The machines run continuously and the building is locked up. Only periodic visits are required by mechanics and supervisors. When the industrial executives of the country as a whole recognize the value of modern automatic machinery to this extent almost everything in the way of high wages and short working hours may be possible.

Incidentally, the president of the great power company that owns this plant made some remarks that seemed to tie together the many progressive ideas that were evident in the new industries all over these eight southeastern states. He stated that the South is fortunate in that its industrial development was delayed until this present era. Having learned the lessons from other states of the North there is little danger at this period that the new industrialists will give the cause that makes for industrial unrest. Never before in history were there more friendly feelings between labor and management, and the South is now drawing on a great supply of intelligent native white labor at a time when mutual understanding and goodwill is appreciated on both sides. Moreover, thousands of factories are being equipped and new industries started with the most modern labor-saving machinery without the handicap of old and obsolete plant.

Simplifying and Improving Machine Design

By Tom Addison

A DESIGN that reduces the total number of parts and yet produces the same final result, may be of interest to designers generally. This design is not claimed to be new, the writer first noticing this construction in 1922 on the design of a Cleveland milling machine. It is also incorporated on all the heads of the Cincinnati "Hypro" planers.

The original design consisted of a small shaft turned down at the ends, on which miter gears were keyed, these gears in turn being held from endwise movement by screws as shown at *A*, Fig. 1. This design required seven pieces in all consisting of a shaft, two gears, two keys and two setscrews. The distance between the

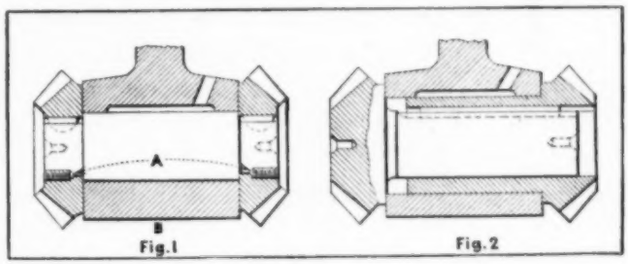


Fig. 1 is inferior to Fig. 2 in number of parts, cheapness, and bearing area

shoulders on the shaft and the length of the bearing *B* had to be held to close limits to allow freedom of rotation of the unit. It was also necessary to hold the overall length of the shaft and of the hubs of the gears to close limits to enable satisfactory drilling and tapping for the setscrews. Necking at the shoulders also reduced the total surface for accurately fitting gears to the shaft, and finally, one gear had to be pressed on in place.

The final design, as shown in Fig. 2, consists of only the three parts, i.e., two miter gears both having extensions, one sliding in the other, and a key. This key could naturally be omitted if splining is employed. This design is also superior in many other ways. It facilitates matching the lengths of the extensions on the gears.

Fillets on both extension shafts can readily be added, producing extra strength. A larger diameter of bearing is obtained automatically, permitting the use of larger tools both for boring and facing operations. Better lubrication is also obtained due to open space between gears. Assembly is greatly simplified, and there is less tendency for gears to run "out of true."

Executive Planning for Tool Equipment

There are still a surprising number of important plants that use cut-and-try methods of tooling up for production, instead of making models and planning the tool equipment carefully. Is it because executives have looked only to production without summing up in advance the steps to economic production? In the April 25 issue of the *American Machinist* will begin a series of articles that will tell the higher production executives what they should look to in planning tool equipment for efficient manufacture.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Should We Buy Tools by the Pound?

"HAVE you been reading about this new steel for lathe and planer tools, Al? Must be great stuff for some things. They say you can cut a thread on a glass rod with it, but, of course, that's a stunt, and no one wants to do it. And did you see what they want five hundred dollars a pound for it? No steel can be worth that, Al. They must want to be millionaires in a minute."

"Yes, I've been watching the news about the new cutting tools. But there's no use going off half-cocked about them, either way. I've asked Williams to get one or two tools to try on that pump job."

"You've got a nerve to ask for five-hundred-dollar-a-pound steel. Of course Williams turned it down."

"Oh no, he didn't, Ed. If you'll just get the 'steel' idea out of your head you'll be able to think straight. This isn't 'steel' at all, but a special, extra-hard metal for cutting. It's first cousin to a diamond—and even you wouldn't balk at five hundred dollars a pound for diamonds, if we could use them on our work."

"But I can't imagine any metal for tools costing that much, Al."

"If it cost as much as that, they'd have to charge double that money for it. They've spent a wad of money experimenting, and they've got to get it back. We users must pay for it, if we want to use it. That's fair enough, isn't it?"

"But they would have to cut a hundred times as fast as five-dollar-a-pound tools to pay for themselves, Al."

"Wrong again, Ed. Cutting speed isn't the only thing to consider. Setting-up time is a big item on many jobs. And this means not only the time of the man, but the time the machine is idle. If these new cutting tools will run from ten to a hundred times as long between grinding as the old tools, you can see what the saving is, even at the same cutting speed."

"But five hundred dollars a pound for steel—"

"Forget the word 'steel' Ed. This isn't steel. Call it a super-hard cutting tool. Remember it will cut steels so hard that high-speed tools won't touch them. It will cut manganese steel, and we used to have to grind that."

"But the price, Al—I can't get over that."

"Your idea of economy keeps a lot of people poor, Ed. You kept your old, leaking carbureter because you thought the price of the new one was too much. And you paid for it in wasted gas several times over. It's time you learned that it isn't the first cost that counts, but results."

Is Ed's objection to the cost natural—or reasonable? Or is Al's contention, that only results count, right? How many overlook first cost?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

The Exit Interview

ONE of the largest manufacturing concerns of this country spends a considerable sum of money each year in attempting to reduce labor turnover, and I consider their method of investigation to be about as good as can be found. In this concern, under the supervision of the personnel manager there is a department which spends its entire time co-operating with the employees, and seeing to it that many of their desires are satisfied. The method in which this work is carried on is as follows: Questionnaires are sent to each employee every six months, in which are the following questions: What is your method of commuting to and from the shop? What is the time required? Do you consider it satisfactory? Have you any suggestions for bettering plant conditions? Do you consider your job to be satisfactory? If not, is there another one which you think you can fill to our mutual satisfaction? Do you think the heating and ventilation near your particular location is satisfactory? There are also other questions along the same lines.

When these questionnaires are all returned, the data is compiled under regular headings, and where it is deemed necessary, contact is made with the various divisions of the plant to correct unsatisfactory conditions. We have found, after a period of three years, that the labor turnover has decreased about one-half, and that the class of help we now employ is above the average.

—FRED AUG. SCHMIDT, *Industrial Engineer.*

Letting Small Savings Offset Larger Wastes

TOOLS, no matter how small, should be issued from the toolcrib upon requisition from an authorized source. They should be issued to workmen only upon presentation of a check or receipt that will locate them in the shop, and fix responsibility for their return.

The use of a check system will teach the men the value of small tools, and effect a reduction of factory waste by making them responsible for their care and ultimate return to the toolcrib. —G. H. GUNN.

Helping the Tool Designer

THEORY and experience are two good horses. Teamed up, they make a wonderful team, used individually, not so good. Theory, as represented by the designer, and experience, by the foreman, will pull well, together, if each one will acknowledge the possibilities of the other.

If two or more people are responsible for anything, they will not be so prone to criticize, but will do their utmost to make it a success. Co-operation is a necessity where several people work together, and any method to secure this co-operation is commendable.

—P. H. PEARSON.

THE · NEXT · TOPIC

Keeping Posted on New Tools

ADVANCE QUESTION

Ed finds Al studying circulars and thinks he's wasting time. Says it's Williams' job to post them about anything they need to know. Al prefers to be informed ahead of time. Is this the foreman's job?

More Responsibilities for the Foreman

THAT first pieces should be checked is unquestionable. However, I feel that for the foreman to do so is not the best procedure. The best way to get men to accept responsibility is to thrust it upon them. If the foreman is to be on hand to check every move, they will learn to depend too much upon him and will lose, or fail to develop, their own initiative. It will also retard the foreman in his bigger function of planning, organizing, and co-operating with other departments. Because he will be at the constant call of his men he will lose also his opportunity to do the bigger things he is in a position to originate.

I would have an inspector check all first pieces. This inspector should report to a chief inspector, whose organization should be independent, or linked up with the engineering department. Under no circumstances should this inspector come under the foreman.

—JOHN A. THOMSON.

Instructors for Shop Men

EVOLUTION brings machine tools on the market which are so different from their predecessors that even well-trained men fail to secure the best possible output from them. In saying this I have in mind machines using two or more tools simultaneously.

In some cases it is necessary to draw up a real "timetable" for tool movement. If left to the operator he seldom chooses the best way because he is guided largely by feeling. In special cases I instruct the men myself, but I realize that this instruction should be given by the foremen, and am training them to do it. I can understand Ed's dislike of "this teacher stuff," but he must either instruct, or have an instructor do it.

—FRANZ BERMAN, *Austria.*

· BOOK · REVIEWS ·

THIS ECONOMIC WORLD AND HOW IT MAY BE IMPROVED. By Thomas Nixon Carver and Hugh W. Lester. Four hundred thirty-two 6x9-in. pages. Cloth-board covers. Indexed. Published by the A. W. Shaw Company, Chicago, Ill. Price $4.

ONE thing that can be said for this volume is that it is unusual in its field. There is a theme of industrial and business relations running through the book, but it is much obscured in a maze of arguments covering the whole field of economics, much that is interesting, but also much that is irrelevant. The book is a strange mixture of liberalism and intolerance, and just a suggestion of the idea that the only proper conclusion is what the writers themselves believe. Theories, when desired, are backed up by arrays of supporting argument, but on the other side silence is too often maintained. Certain fundamental facts are ignored, namely, that Adam Smith is hopelessly dead, that we laud tomorrow what we jail for today, and that only three per cent of the population of the world lives in the United States.

The chapters on the legal problems, especially that on "Equality Before the Law," are outstanding, and justify the book. In all there are thirteen chapters in the book, taking up such topics as: The present state of liberalism, the competitive system, economic equality, the supposed necessity for an industrial reserve, and how long will this diffusion of prosperity last? The reader will not expect to find here solved all of these problems, but he will find a live discussion that should give him ample food for thought.

S.A.E. HANDBOOK—1929 EDITION. Six hundred eighty pages, 4⅛x7¼ in. Published by the Society of Automotive Engineers, New York. Free to members. Price to non-members $5.

EACH year shows changes in standards recommended by the society, indicating that it is progressive, and also that standardization stabilizes industry, but does not prevent the adoption of improvements being made as rapidly as seems necessary. This handbook now contains more than 600 specifications, most of them in general use in the automotive industry, while some are universal. It is conservatively estimated that these standards have saved 15 per cent in the total retail value of American automotive products. It is a standard reference book for all interested in any way in automotive products.

PRODUCTION PLANNING—ITS ENGINEERING ASPECTS. By John W. Hallock, professor of industrial engineering, University of Pittsburgh. One hundred and seventy-two 9x6 in. pages. Thirty-six figures. Indexed. Published by the Ronald Press Company, 125 East 26th St., New York, N. Y. Price $4.

MEN in the field will be glad to learn that a book has finally been written that treats production planning and control from the scientific and mathematical standpoints, rather than dealing in useless generalities. By showing how to use mathematical relationships and computations on practical problems, the book strives to give an understanding of how to secure and use quantitative facts, upon which decisions as to working procedure may be reached. Principle, method and business expediency are balanced in the way in which they are found under operating conditions.

Out of thirteen chapters in this handy book, three will be named to show its scope. These are: Determination of Machine Capacities, Computing Process Times and Material Handling in Controlled Production. The volume is suitable both for classroom presentation and as a ready reference for the use of the experienced operating man.

PROFITABLE PERSONNEL PRACTICE. By Henry Bruère and Grace Pugh. Four hundred fify-four pages, 5½x8 in., cloth boards. Indexed. Published by Harper & Brothers, New York. Price $4.00.

THERE is nothing theoretical about this book, nor has it any particular axe to grind in the way of a pet formula for satisfying the industrial worker. Instead it furnishes in pithy form descriptions and analyses of outstanding personnel practice used in all kinds of American manufacturing plants and in public utilities. What is more, and what makes the book so readable, is the fact that company names are used throughout, many of which are outstanding, so that the volume represents a symposium of successful methods. The information presented was gathered by direct inquiry by the Policyholders Service Bureau of the Metropolitan Life Insurance Company and by the authors and others associated in the work of this unique department of the company as a by-product of its group insurance work.

The book starts at the factory door where the hiring is done and discusses the important item of job placement. Measures to increase the productivity of labor are taken up in Chapter II, and the ways of enlisting employee co-operation, in Chapter III. Other chapter headings show the wide scope of the book: Stabilizing operations, sharing ownership, provision against risk (insurance), accident prevention, protecting health, vacations, recreation for employees, food for workers, employee magazines, mutual aid, and savings plans. Some interesting examples of modern psychology applied to management are given, as well as some practical suggestions for the personnel manager. In the concluding chapter a case problem of developing a program is presented. A rather complete bibliography is appended.

THE LITTLE LIBRARY OF SELF-STARTERS. By Robert R. Updegraff. Six volumes, each of about 60 pages, 4½x7 in., bound in paper covered boards, in a pasteboard container. Published by A. W. Shaw Company, Book Division, Chicago. Each volume, 75 cents; the set, $4.

THE six stories contained in this set of little books are really much better than the blurb on the jacket would lead one to believe. They are inspirational, it is true, but they are well written besides. Each seeks to deliver a business message, some in story form, others as essays.

It takes only about twenty minutes to read one. The set could well serve as a personal gift to a business acquaintance or as entertainment for visitors in the waiting room while the busy executive is "in conference." If used for the latter purpose the effect should be to improve the frame of mind of the waiter when he finally is granted admittance.

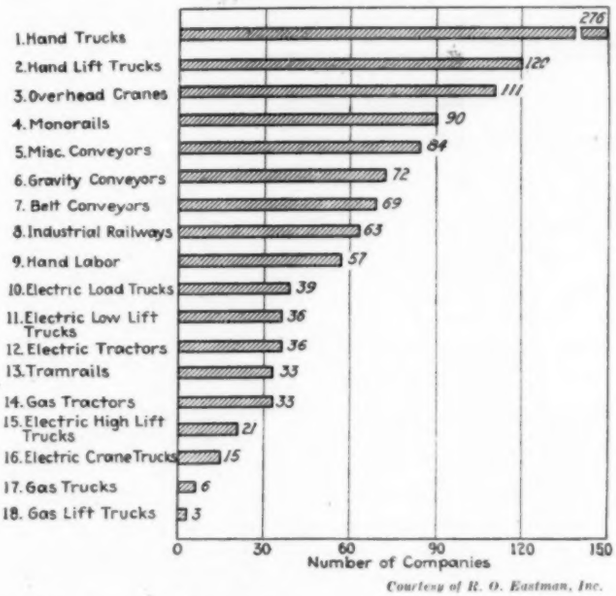
Expediency Influences Material Handling

By W. E. IRISH
Research Editor, American Machinist

In the reasons themselves, for a given choice of material-handling equipment, lies opportunity for plant improvement

A CERTAIN metal-working plant uses hand trucks, principally, for handling materials and parts through the manufacturing departments. Another uses conveyors. Yet another has an overhead system. These plants were recently asked why their preference for these hand trucks and conveyors and track over the possible use of other types of material-handling equipment.

Among other reasons, the investigator was told that narrow aisles, narrow doorways, bad floors, differing elevations of departments, small elevators, short hauls,


1. Hand Trucks 276
2. Hand Lift Trucks 120
3. Overhead Cranes 111
4. Monorails 90
5. Misc. Conveyors 84
6. Gravity Conveyors 72
7. Belt Conveyors 69
8. Industrial Railways 63
9. Hand Labor 57
10. Electric Load Trucks 39
11. Electric Low Lift Trucks 36
12. Electric Tractors 36
13. Tramrails 33
14. Gas Tractors 33
15. Electric High Lift Trucks 21
16. Electric Crane Trucks 15
17. Gas Trucks 6
18. Gas Lift Trucks 3
0 30 60 90 120 150
Number of Companies

Courtesy of R. O. Eastman, Inc.

Fig. 1 — Distribution of material-handling equipment in 300 industrial plants. Due allowance should be made in checking the relative importance of these types of equipment in that 80 of these companies cannot be classed as manufacturers

and general department congestion influenced the choice, all of which may have been fair enough reasons in that certain plant.

But what of these narrow aisles and bad floors and general congestion? The Electrical Industrial Truck and Tractor Group of The Society for Electrical Development, Inc., decided to make an investigation in order to find, if possible, the controlling conditions in the whole problem of materials handling. Accordingly, a firm of engineers was retained to send investigators into the field. The facts that were turned up have thrown a good deal of light on the extent to which expediency influences the choice of material-handling equipment. They indicate numerous opportunities to exist in the average plant for considerable improvement over conditions now existing. High points from the investigation are reproduced here to give the user a fair picture of the present status in some 300 industrial plants.

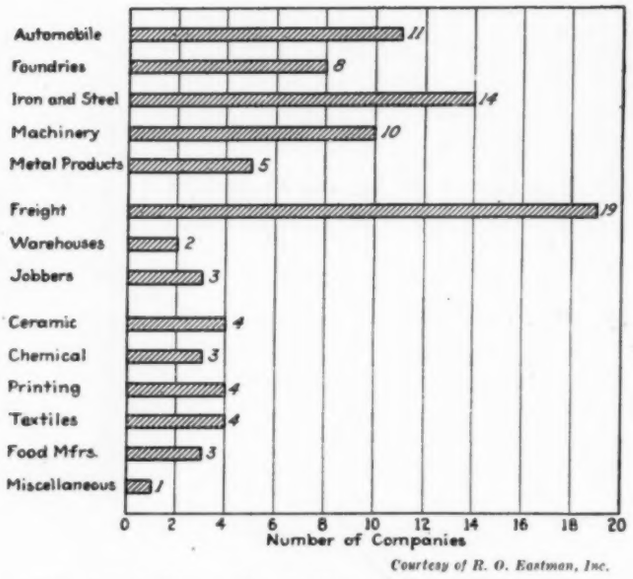
The investigation was purposely spread through the major branches of industry, but, as was to be expected, the major part of the picture came out of the metal-working plant division. The study shows, in fact, that this division stands out from all of the others in the diversity of its material-handling problems.

The plant divisions and the number of plants in each into which the investigators went are shown in the following list. Those that belong, in whole or in part, to the metal-working division are in bold type:

Automobile and parts manufacturers	**22**
Foundries	**20**
Iron and steel mills	**20**
Machinery manufacturers	**25**
Other metal product manufacturers	**20**
Freight terminals	33
Public and private warehouses	22
Jobbers	25
Ceramic manufacturers	18
Textile manufacturers	14
Food and tobacco manufacturers	19
Chemical manufacturers	22
Printing and publishing companies	17
Miscellaneous industries	14

The investigation was made with a number of main purposes, the first of which was to find the number of companies employing each of eighteen types of material handling equipment in one or more of their major handling operations. The results are shown in Fig. 1. The next step in the interests of the electrical equipment was to evaluate the industrial divisions as to their use of electrical trucks and tractors. Here, as shown in Fig. 2, the importance of the metal-working division is clearly indicated. It is of interest that the investigation disclosed an average of 4.1 types of material-handling equipment in use in each plant.

Following this study, the various divisions of materials-handling activities were grouped and the number of companies interested in each group was determined. Here, as shown in Fig. 3, there are eleven major groups of material handling activities, of which four stand out in their importance over the others. Very apparently,



Courtesy of R. O. Eastman, Inc.

Fig. 2 — Industry distribution of 91 companies that were found in the 300 investigated to have some type of electric truck or tractor

the problem of moving material upon its receipt at the plant and through the manufacturing steps is more important than after it reaches assembly and is started to the shipping platform. It may well pay many manufacturers to investigate conditions beginning at assembly, if for no other reason than that this story shows a general belief that there is no problem comparable with those at the start of production.

Supplementing this division of the study, the number of companies using each type of material-handling equipment for each of the eleven activity groups was determined. The results, shown in Table I, indicate the general adoption of mechanical equipment for moving materials in process, but a retention of hand equipment when the product is in finished form.

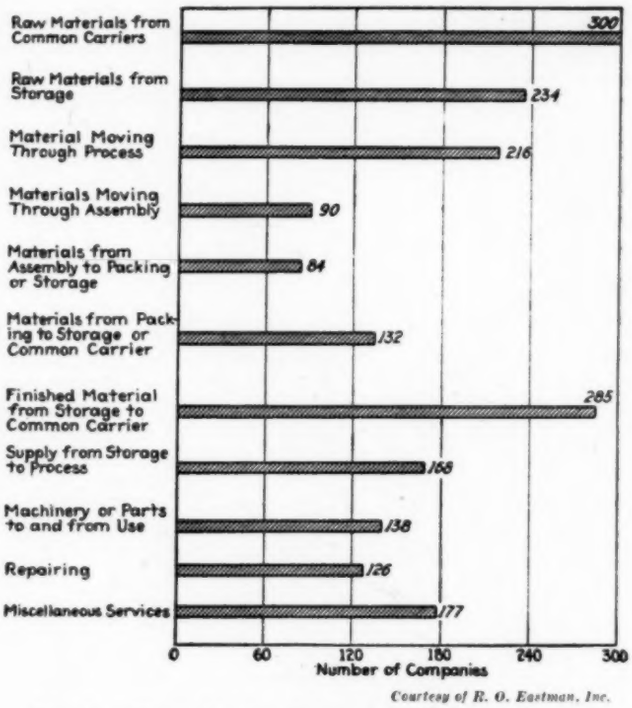
This part of the investigation also provides a measure of the versatility of the various types of equipment. The measure is arrived at, as illustrated in Fig. 4, by averaging the number of operations performed by each type.

Finally, the investigators determined the reasons for preference for given types of equipment by each plant, based upon plant conditions and upon characteristics of specific equipment. It is in the reasons given here that the present user of materials-handling equipment can find the most food for serious thought.

These reasons have been set down in Table II as they were advanced by the users of each equipment type. It is seen, for example, that the users of hand trucks prefer them largely because of physical plant conditions. More than half considered that the hauls were too short to warrant electrical truck equipment. One-fifth said that aisles were too narrow to permit maneuverability. Some thirty plants reported bad floors. It would be of particular interest to know in how many of these plants these conditions are needlessly interfering with efficient operation. There would, doubtless, be a number of surprised manufacturers, were they to check up on these conditions.

These statements by no means imply poor methods, because the plant is not laid out to accommodate the most efficient material-handling equipment. They do indicate the very likely room for improvement in many cases of items of plant condition that are easily passed up in a busy day without fair realization of their importance.

It is of interest to follow the study a step further to



Courtesy of R. O. Eastman, Inc.

Fig. 3 — Chart showing the use of each of eleven major material-handling operations by the investigated plants. Since 80 non-manufacturers use only moving from and to common carriers, the relative importance of the remaining operations may be studied by subtracting these two operations from the total number

Table I—Companies Using Each Type of Equipment for Each Material Handling Operation

Operation number from previous chart	1	2	3	4	5	6	7	8	9	10	11
Hand trucks	189	185	185	159	199	201	235	246	220	219	260
Hand lift trucks	74	89	97	78	90	97	68	69	53	45	61
Gasoline trucks	...	...	3	4	...	...	1	5	11	10	23
Gasoline lift trucks	1	...	2	7	...	...	1	2	2	...	...
Gasoline tractors	13	14	16	14	...	10	11	39	41	35	30
Electric load trucks	20	13	22	7	7	2	28	32	34	44	34
Electric low-lift trucks	16	19	35	18	15	10	17	24	18	20	18
Electric high-lift trucks	10	11	16	7	11	12	12	8	14	8	11
Electric tractors	24	14	16	14	11	14	31	19	14	20	16
Electric crane trucks	2	3	6	4	...	2	5	5	14	17	12
Industrial railways	22	35	50	21	12	17	17	9	7	10	12
Monorails	22	22	78	39	8	10	20	13	5	8	8
Overhead cranes	57	83	101	71	30	29	25	19	80	49	30
Tramrails	6	15	31	4	4	5	4	2	5	...	2
Gravity conveyors	20	25	61	28	53	45	30	11	9	8	12
Belt conveyors	12	14	68	25	11	14	10	9	2	...	5
Other conveyors	19	13	73	39	11	10	14	13	...	...	4
Hand movement	24	14	20	32	23	19	20	19	11	10	12
Average number of types used on each operation	1.8	1.9	3.0	1.9	1.6	1.6	1.8	1.8	1.8	1.7	1.8

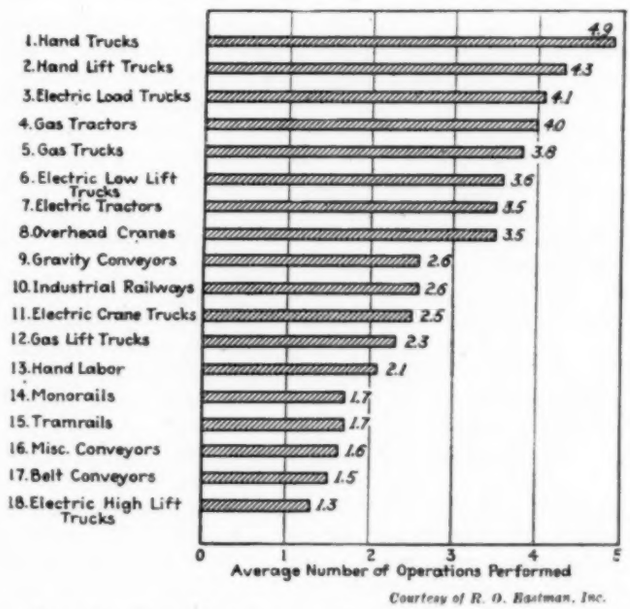
Table II—Number of Companies Reporting Reasons for Preference of Each Type of Material Handling Equipment Used

*Equipment number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Total number reporting	260	110	100	80	74	72	64	57	46	32	32	32	31	29	18	13
Narrow aisles	52	23	11	8	..	..	1	2	1	..	..	..	2	1	..	..
Narrow doorways	16	6	3	2	1	..	..	..	..	..	..	..	..	1	..	..
Bad floors	29	10	16	13	..	..	..	12	..	..	..	..	1	19	..	..
Different elevations	21	8	14	13	9	22	6	1	2	..	..	..	4	1	..	..
Small elevators	16	7	3	1	..	..	..	..	..	..	..	..	..	..	..	..
Short hauls	146	66	6	1	3	4	5	1	27	..	..	..	3	..	..	..
General congestion	21	13	27	9	..	..	..	..	1	..	..	..	4	1	..	..
Equipment investment	5	2	10	4	5	2	8	8	1	..	..	..	1	2	..	..
Other plant conditions	2	1	3	1	2	..	1	1	..	..	..	..	..	..	1	1
Low investment	21	19	..	1	2	9	3	1	1	..	..	..	..	3	..	..
Low maintenance	10	3	..	2	8	16	8	10	1	..	1	1	1	1	2	2
Low total costs	12	7	2	5	20	18	16	2	5	15	10	12	..	2	4	8
Maneuverability	29	13	6	2	1	..	..	2	..	1	4	2	1	1	4	4
Saving in floor space	2	2	24	7	1	1	1	..	..	1	..	2	2	..	3	..
Flexibility	16	4	3	..	..	..	..	1	1	..	..	..	..	2	..	..
Product protection	8	3	..	1	..	2	1	1	..	2	4	2	1	..	1	..
Other equipment reasons	..	13	8	8	17	9	10	13	2	16	23	24	6	14	8	4
Plant conditions	206	86	59	37	18	25	20	25	31	..	..	4	13	25	2	3
Equipment characteristics	94	44	38	19	43	40	30	21	9	23	24	21	7	18	15	10

*1—Hand Trucks
2—Hand Lift Trucks
3—Overhead Cranes
4—Monorails
5—Misc. Conveyors
6—Gravity Conveyors
7—Belt Conveyors
8—Industrial Railways
9—Hand Movement
10—Electric Load Trucks
11—Electric Low Lifts
12—Electric Tractors
13—Tramrails
14—Gas Tractors
15—Electric High Lifts
16—Electric Crane Trucks

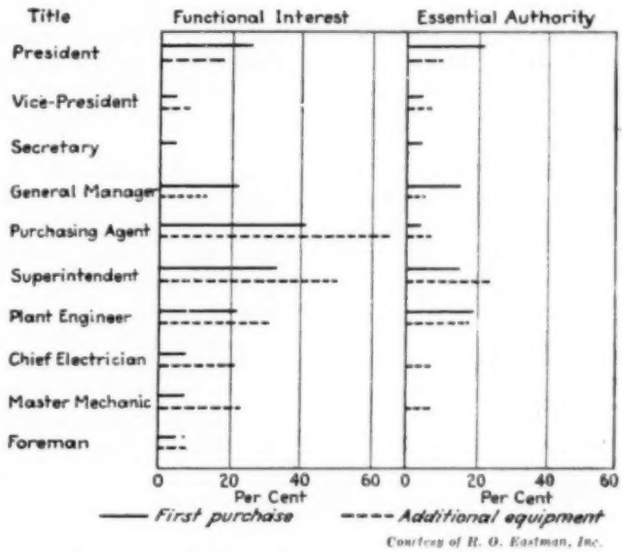
find who it is in the average plant that is interested in the material-handling equipment and the difference that exists to a marked degree between interest and responsibility. The information secured on this point by the investigators is charted under two heads in Fig. 5. One of these heads has to do with the various officials who function in the selection of material-handling equipment. The other has to do with relative importance of those interested. Of course, the equipment meant here has principally to do with electric trucks and tractors, but in any major purchase of material-handling equipment, the same conditions as illustrated will hold.

Quoting from the report made by the investigators, "The purchasing agent, more frequently than anyone


1. Hand Trucks 4.9
2. Hand Lift Trucks 4.3
3. Electric Load Trucks 4.1
4. Gas Tractors 4.0
5. Gas Trucks 3.8
6. Electric Low Lift Trucks 3.6
7. Electric Tractors 3.5
8. Overhead Cranes 3.5
9. Gravity Conveyors 2.6
10. Industrial Railways 2.6
11. Electric Crane Trucks 2.5
12. Gas Lift Trucks 2.3
13. Hand Labor 2.1
14. Monorails 1.7
15. Tramrails 1.7
16. Misc. Conveyors 1.6
17. Belt Conveyors 1.5
18. Electric High Lift Trucks 1.3
0 1 2 3 4 5
Average Number of Operations Performed

Courtesy of R. O. Eastman, Inc.

Fig. 4 — The relative versatility of each type of material-handling equipment as it is used in the 300 investigated plants



Courtesy of R. O. Eastman, Inc.

Fig. 5 — Functional interest and essential authority compared in the purchase of new and of additional equipment. The titles shown do not include those which apply to the freight terminals and similar plants

else, appears in the transaction. He is not, however, the most important man. Because of the standard routine of having all orders and specifications pass through the hands of the purchasing agent, he is naturally the one who appears most frequently in the picture.

"The other people who appear in the transactions involving the first purchase of equipment are, in order of their frequency, the general superintendent or works manager, the president," [more from the standpoint of granting appropriations than from personal specification at the start] "the general manager, and the plant engineer.

"From the standpoint of essential authority in the transaction," the report goes on to say, "in the purchase of the first truck, the president is the most important

man," [here again the president grants the request for appropriation rather than initiates specific action] "and next in importance comes the plant engineer, who is followed by the general superintendent or works manager and the general manager."

Upon these men, therefore, devolves the responsibility, not only of selecting the equipment which best fits their plant conditions and handling needs but also to make certain that the plant conditions are as they should be in order to obtain the best manufacturing results before settling permanently on any type or make of equipment to meet their material-handling problems.

Standardization Applied to Planers

By Tom Addison

A REAL effort at standardization and simplification has been made by one of the leading manufacturers of metal planers, the plant of the Cincinnati Planer Company. Some of the results accomplished will be of value in other plants. These planers are of both the openside and double housing types and also include a line of planer-type milling machines.

When confronted with the problem of designing and manufacturing an improved line of machines, the company was listing and making eleven major sizes of double housing planers ranging from 22-in. to 120-in. in width, from 5-ft. to an unlimited length of table, and in varying heights. Machines ranged from approximately 2,000 to 150,000 lb. Each major size had also a full range of patterns entirely separated from the remaining sizes, making a high inventory at all times.

Planer variations are great in number, and may be summed up as follows: Width, height, length, single railhead, double railhead, single railhead, and right-hand side head, double railhead and right-hand side head, single railhead and two side heads, double railhead and two side heads.

Then again there are drive variations such as: Belt drive and countershaft up to 60-in. in width, belt drive with motor on machine, and reversing motor drive with right and left hand. From the above line-up it can be noted readily that simplification was not an easy problem.

Elimination of total number of major sizes was the problem tackled first, and in conjunction with competitor sizes, five major sizes were decided upon, ranging from 30 to 96 in. in width, all equipped with graduated feed, rapid traverse, forced lubrication, and unit lubrication at remaining points, together with steel rack and gearing for the table-driving mechanism. Safety features and ease of operation were stressed.

A majority of designers and dealers drift into the habit of using their own plant facilities for producing all parts in the construction of their machines. The idea was corrected to a great extent in the above instance. For example, connecting rod ends were formerly made of cast iron or cast steel. Today, drop forgings are bought finished, including pins and cotters, at much lower cost. These are used throughout the range of machines. These drop forgings are used in the automotive industry, and hence the cost of dies were eliminated.

Railhead clapper boxes, and their clamps and slides on one size, were readily arranged to become part of the side head of the next larger size, greatly reducing the details of manufacture. All of the rail clamp mechanism details, such as brackets, bevel gears, and shaft ends are used throughout the full range, making it possible to produce in quantities five to ten times larger than formerly. The same condition also applied to the feed mechanism, although two primary sizes were required.

Railhead and side head feed mechanisms were made the same on one machine, or more. The bevel gear unit assembly at the lower side of the housings, driven from the main table gearing, was designed to be interchangeable throughout the whole range of both double housing and openside types. This unit is also added to the left side housing when the left-hand side head is required. This particular assembly can now be made in fairly large quantities.

Table trip dogs, and the shifting mechanism for reversing motor drives, cover the whole range of sizes and types of planers. The oil filter and all other fittings for forced lubrication also cover this full range.

Due to variation of weights of crossrails to be raised and lowered, two primary sizes of combined elevating and rapid traverse mechanisms were necessary for these five primary sizes. This elevating unit was so arranged that it would add or remove the left-hand side head as the customer desired. Later, if the customer wished a left-hand side head, full provision for it with the least possible changes was there. Reversing motor drive details were arranged so as to make them right or left hand according to the desire of the customer or the location of the machine, the housing bearing being the same for either right or left hand.

Rack sections were made to a standard length of approximately four feet. This size enabled them to take care of the length increment, which is two feet, by merely cutting a section into two equal parts. Minor details such as trigger gears, shifting lever units for feed and rapid traverse motions, clamps, etc., were made fully interchangeable for the full range of sizes.

All squares for crank handles were made the same size, as were the nuts that had to be tightened, eleminating a stock of crank handles and wrenches to be shipped with each machine. Special threads were also eliminated. Brackets and all details subject to right-and left-hand application were designed to make them symmetrical, eliminating left-hand drawings, patterns, and castings. Counterweight brackets for the side heads, sheaves, bolts and studs, and all details for fastening them, were designed together with a sufficient weight so that they can be applied to each major size.

The total number of details for the whole range of machines was thus decreased to a minimum with resultant decrease in the cost of production and of overhead. Better delivery was also obtainable due to the fact that larger units such as crossrails, side heads, etc., could be built for stock.

The manufacturer of a well-known line of shapers dealt with this problem in the same manner, and 67 per cent of all parts for their complete line are now used in each size of shaper produced. Lathe manufacturers can also secure wonderful results along these lines. Cylindrical grinders are becoming more standardized daily. The same principle applies to radial drilling machines, the diameter of column depending upon the range of the arm and head.

Conversion of Hardness Numbers

By Alfred Heller

Secretary and Treasurer, Hercules Electric Steel Corporation

Hardness distribution in the body of the steel is often as important as surface hardness in the use of hardened parts, and also in hardness measurements

IN EXPLAINING the fact that a single conversion curve cannot be obtained for all steels, the next step is an investigation of the hardness penetration and hardness distribution in carbon steels.

It is to be regretted that there is little information available on this subject, as it is an exceedingly important matter to know not only surface hardness but core hardness as well. For example, it will be shown that a piece of 1.10 per cent carbon tool steel hardened at 1,390 deg. F. has a surface hardness of C-68.3 and, at the center of a section one in. sq., a core hardness of C-40.0. There is a vast difference in physical properties of steel from Rockwell C-68 to C-40.0 and, therefore, in determining the ability of a machine part, die, or tool, to withstand certain stresses, it is as important to know the hardness penetration and hardness distribution throughout a section as to know the surface hardness.

Bolt manufacturers, for example, know that alloy steels, with the exception of a straight vanadium steel which develops shallow hardness penetration, do not give results in cold heading. Alloy steels often break. The reason is that alloy steels harden clear through, whereas carbon steels have a soft tough core. Again, for many kinds of cold pressing, and cold drop-hammer work, alloy steels are the only ones that will answer, because of their deep-hardening qualities, plain carbon steel for ordinary sized dies always showing a soft core no matter what the hardening temperature may have been, and under the high pressures developed often "sinking" (deforming permanently in direction of the pressure).

Reference to Fig. 11, sample No. 1, shows the hardness penetration and distribution in a 1.10 per cent carbon steel sample, 1x1x1¼ in. and on a section one-half inch from the end. A 6x$\frac{1}{16}$-in. flexible grinding wheel was used in cutting these sections, and the cutting was done as carefully as possible to prevent drawing the temper. For sample No. 1, which was not drawn, it may be possible that the first few readings from the outside are a little low due to the wheel slightly drawing the temper of this extremely hard-surface steel. This error may possibly exist to a somewhat less degree for sample No. 2 drawn to 350 deg. F., but cannot exist on the other samples shown because of the high drawing temperatures.

As can be seen, steel of uniform hardness exists to a depth of 0.040 or 0.050 in. after which the hardness rapidly diminishes and approaches that of the center.

Samples of 1.10 per cent carbon steel were prepared 1x1x$\frac{3}{8}$ in., 1x1x$\frac{1}{2}$ in., and 1x1x$\frac{3}{4}$ in., and the differences in hardness penetration and distribution between these samples and the 1¼x1x1-in. sample noted. It was found that the penetration of uniformly hard steel to a depth of 0.040 or 0.050 in. was the same for all samples, and that after this the rate of change was the same. In other words, if the 1x1x$\frac{3}{8}$-in. sample was tested at a point 0.090 in. from an outside surface, and far enough away from a corner so that the accelerated cooling in the region of a corner had no effect, and the 1x1x1¼-in. sample tested at the same distance from an outside surface, then the hardness values obtained at these points would be exactly the same. Therefore, in the case of steels which show a soft core, the rate of change of hardness from an outside surface toward the center is the same irrespective of the mass of the section. This does not mean that the core hardness for the $\frac{3}{8}$x1x1-in. section will be the same as the core hardness of the 1x1x1-in. section, but that the core hardness of the $\frac{3}{8}$-in. section is the same as that of the 1x1x1¼-in. section taken $\frac{3}{16}$ in. below the surface. The rate of change of hardness is the same in both cases.

Table IV—Maximum Diameters at Which Steel Cylinders Will Harden Throughout

	Carbon Content, Per Cent	Max. Diam. for Uniform Hardness Throughout
Portevin and Garvin Tests	0.50	0.430 in. (11 mm.)
	1.37	0.510 in. (13 mm.)
	0.81	0.786 in. (20 mm.)
Author's Tests	0.95	0.563 in.

If various analyses of carbon steel be investigated it will soon become evident that they develop different hardness penetration characteristics depending on their analysis and also upon the temperature at which they are quenched. Take for example a 0.95 and a 1.30 per cent carbon steel, both heated to 1,400 deg. F. and soaked for 30 min. at this temperature. This period of time will result in a saturated solution of iron and carbon for a temperature of 1,400 deg. F. There will be undissolved carbon in both cases, but there will be no more in solution for the 1.30 carbon than for the 0.95 carbon steel. It also follows that there will be much more undissolved carbide in the case of the 1.30 carbon steel.

Since carbon in solution determines the hardening ability of a steel, the two steels will have the same susceptibility to hardening as far as carbon in solution is concerned. However, iron carbide (undissolved carbon) is a poor conductor of heat compared to iron (Fe), as all compounds of metals are poor conductors of heat compared with the metals themselves. Hence, the excess of undissolved carbide of the 1.30 carbon steel makes this steel a poorer conductor of heat as a whole than the 0.95 carbon steel. But hardening depends on rapidity of cooling as well as susceptibility to hardening due to

The conclusion of the article.

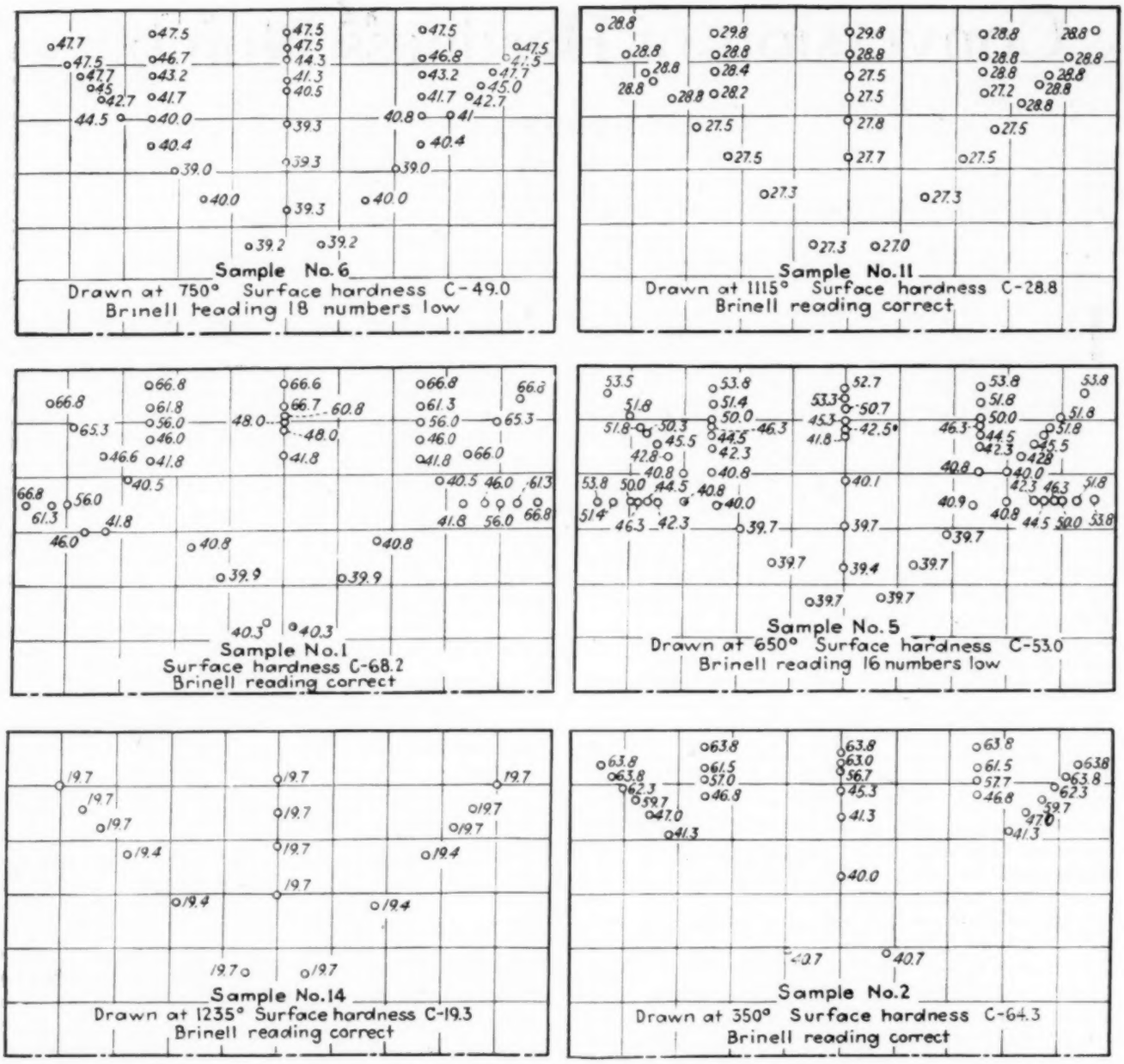

Sample No. 6
Drawn at 750° Surface hardness C-49.0
Brinell reading 18 numbers low
Sample No. 11
Drawn at 1115° Surface hardness C-28.8
Brinell reading correct
Sample No. 1
Surface hardness C-68.2
Brinell reading correct
Sample No. 5
Drawn at 650° Surface hardness C-53.0
Brinell reading 16 numbers low
Sample No. 14
Drawn at 1235° Surface hardness C-19.3
Brinell reading correct
Sample No. 2
Drawn at 350° Surface hardness C-64.3
Brinell reading correct

Fig. 11 — Results of hardness-penetration tests on steel F (1.10 per cent carbon). Samples were hardened at 1,390 deg. F., and drawn as noted in each individual case. Test samples were 1x1x1½ inches

the amount of carbon that is in solution in the steel.

For the two steels, therefore, we have equal susceptibility to hardening as far as carbon in solution is concerned, but a greater susceptibility to hardening for the 0.95 carbon steel due to its greater heat conductivity and consequent faster cooling from an outside surface toward the center. Under these conditions it would be expected that the 0.95 carbon steel would harden deeper than the 1.30 carbon steel when both are heated to the same temperature for the same time and low enough to cause a considerable quantity of undissolved carbide in both cases. This is found to be so, although the prevalent opinion is that the higher the carbon the deeper the hardness penetration.

As before stated there is very meager information on this subject although Portevin and Garvin in *Iron & Steel Institute*, No. 1, 1919, throw some light on the subject. They show, by determining the maximum diameter to which steel cylinders of varying carbon content would harden throughout, that an 0.81 carbon steel is much more susceptible to hardening than lower or higher carbon steels. The results of their investigation are given in Table IV, together with the results of our test on a $\frac{9}{16}$-in. round.

The hardness penetration will vary not only with the carbon content but also with slight variations in manganese content and hardening temperature. The higher the manganese, the deeper the hardening, and the higher the hardening temperature, the deeper the hardening up to that temperature which effects complete solution of the contained carbide.

Another characteristic, more particularly of water-hardening steel, should be understood, and that is what can be called the critical diameter of the steel or that diameter below which the steel has uniform hardness throughout and above which a soft core with much greater surface hardness exists. For example, a piece $\frac{9}{16}$ in. sq. of 0.95 carbon steel will harden uniformly throughout with a hardness of C-66, but a sample $\frac{5}{8}$ in. sq. shows a hardness penetration of some 0.70 in. with a

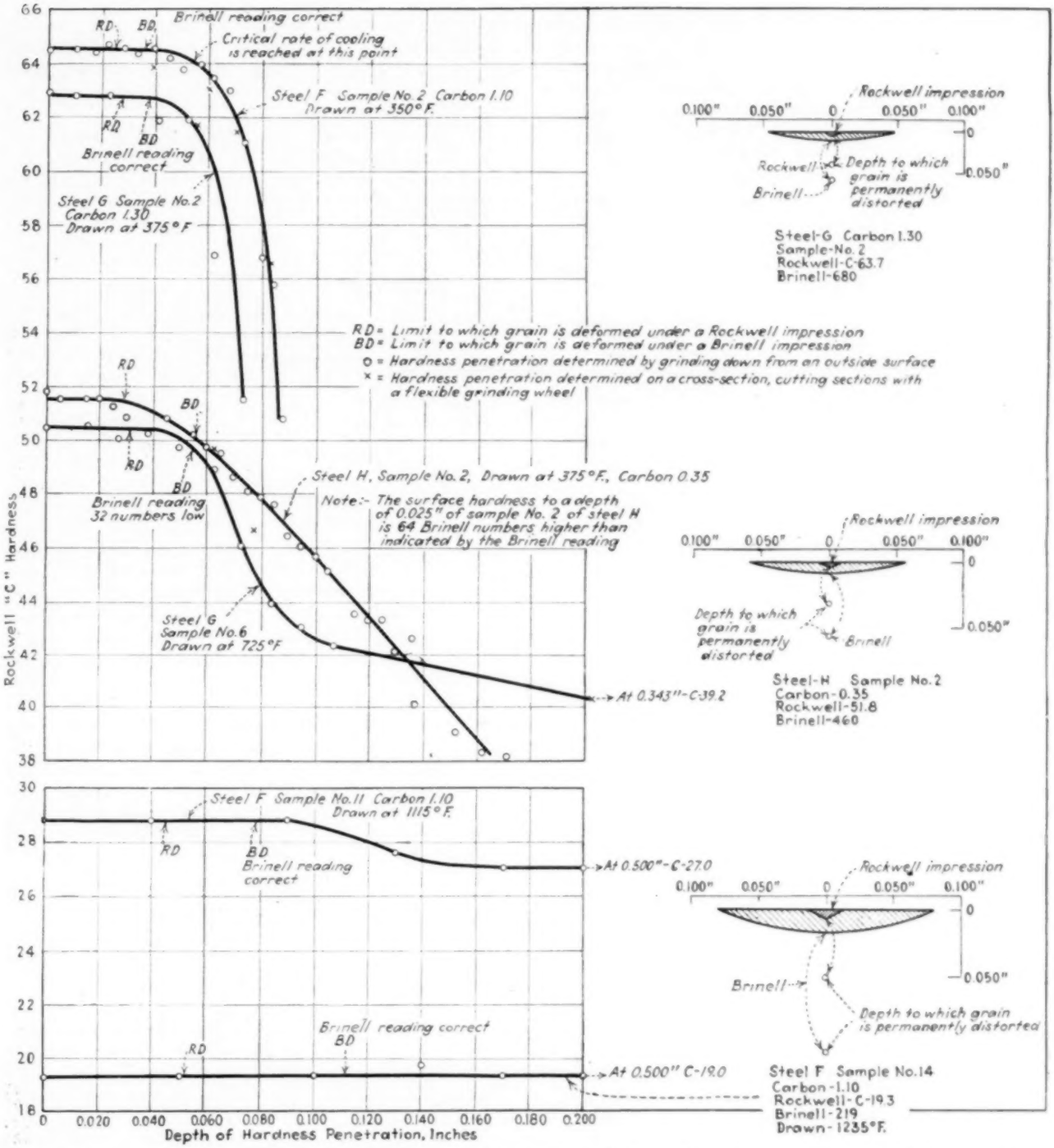

Brinell reading correct
Critical rate of cooling is reached at this point
Steel F Sample No. 2 Carbon 1.10 Drawn at 350° F.
Brinell reading correct
Steel G Sample No. 2 Carbon 1.30 Drawn at 375° F.
RD = Limit to which grain is deformed under a Rockwell impression
BD = Limit to which grain is deformed under a Brinell impression
o = Hardness penetration determined by grinding down from an outside surface
× = Hardness penetration determined on a cross-section, cutting sections with a flexible grinding wheel
Steel H, Sample No. 2, Drawn at 375° F., Carbon 0.35
Note:- The surface hardness to a depth of 0.025" of sample No. 2 of steel H is 64 Brinell numbers higher than indicated by the Brinell reading
Brinell reading 32 numbers low
Steel G Sample No. 6 Drawn at 725° F
At 0.343"-C-39.2
Rockwell "C" Hardness
Rockwell impression
0.100" 0.050" 0 0.050" 0.100"
Depth to which grain is permanently distorted
Brinell
Steel-G Carbon 1.30 Sample-No. 2 Rockwell-C-63.7 Brinell-680
Steel-H Sample No. 2 Carbon-0.35 Rockwell-51.8 Brinell-460
Steel F Sample No. 11 Carbon 1.10 Drawn at 1115° F.
At 0.500"-C-27.0
Brinell reading correct
At 0.500" C-19.0
Steel F Sample No. 14 Carbon-1.10 Rockwell-C-19.3 Brinell-219 Drawn-1235° F.
Depth of Hardness Penetration, Inches

Fig. 12—Showing why shallow hardness penetration results in Brinell readings that are lower than is indicated by conversion charts for deep-hardening steels

core hardness of only C-42 when both pieces are hardened at 1,390 deg. F. A variation of 1.16 in. in diam. causes this radical change in hardness distribution. The explanation is that steel has a critical rate of cooling, and slight variations in the speed of cooling at this point cause large differences in hardness.

The foregoing, therefore, explains why steel D, a 0.80 carbon steel, hardens uniformly throughout, whereas steel E, a 1.20 carbon steel, has a somewhat softer core (Rockwell C-62.0).

Referring to Fig. 11, it will be seen that as the temperature of drawing is increased there are decided changes in the surface hardness and surface shell of hard martensitic steel, whereas the core hardness over quite a range of temperature to all practical purposes does not change. This relation will continue until the surface hardness approaches the core hardness, when both will begin to change, with the surface hardness for a time slightly greater than the core hardness. Sample No. 11 drawn at 1,115 deg. F. shows this condition. However, when a drawing temperature of 1,235 deg. F. has been reached, as with sample No. 14, uniform hardness exists throughout.

In Fig. 12 is shown the hardness penetration as determined by grinding down from an outside surface, 0.005 in. at a time. It is remarkable that Rockwell read-

ings are so little affected when a point is reached in the grinding where the hardness under a Rockwell impression diminishes rapidly. As shown, some points on the curve were determined on a sectional area and some by grinding from an outside surface down. It would be expected that Rockwell readings would be low when the region of fast-diminishing hardness is reached. The curve for sample No. 6 shows low readings, but is affected less than would be expected. Our conclusions on the hardness-penetration and -distribution tests are as follows: (1) Carbon steel of 0.85 to 0.95 carbon content shows greater hardness penetration than either low or high carbon steels, when such steels are hardened at or slightly above their critical temperatures; (2) the critical diameter of carbon tool steel is that diameter above which a soft core is always experienced, and below which uniform hardness throughout the section is obtained; (3) Rockwell readings are only slightly affected by a soft core.

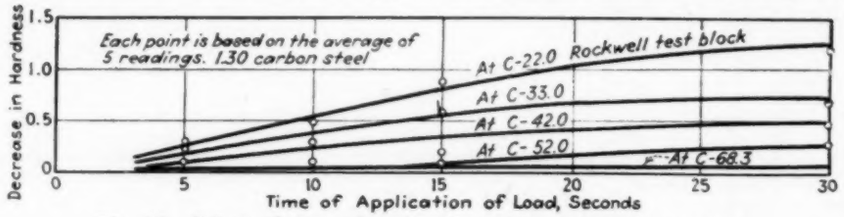


Fig. 13—Effect of time of application of load on Rockwell "C" hardness readings

In Fig. 12 it is shown that a 1.10 carbon steel hardens deeper than a 1.30 carbon steel, and that a 0.35 carbon steel shows the least penetration hardness. The letters BD and RD, respectively, show the depth to which the grain is permanently deformed under Brinell and Rockwell impressions as determined by the gage limits shown in Figs. 8 and 9 in the second part of this article. With drawing temperatures of 350 deg. F. and 375 deg. F. for steels G and F, the deformation of the grain by the Brinell ball is within the limits of steel of uniform hardness and no error results. At 725 deg. F., however, the impression and its deformation are deeper, the latter reaches steel of varying hardness, and the Brinell reading is 32 numbers low if taken from a universal conversion chart. At 1,115 deg. F., uniform hardness is found at a greater depth than the depth of the Brinell deformation, and there is no error. At 1,235 deg., uniform hardness exists throughout the section with no error.

It will be noted that the 0.35 carbon steel, H, sample No. 2, shows the most shallow penetration of steel of uniform hardness of any considered. Consequently, the Brinell deformation reaches well down into steel of variable and diminishing hardness, causing an error of 64 Brinell numbers or about five Rockwell numbers.

From Fig. 12 it will be seen that the Brinell deformation for steel H, sample No. 2, as determined by the gage limits, extends only to steel of about C-50 Rockwell hardness, whereas Fig. 5 would indicate steel at least as soft as C-47. As the permanent deformation limits determined by gage limits assume the use of steel of uniform hardness, it is probable that the Brinell deformation extends deeper than shown, when it reaches into steel of fast-diminishing hardness.

Low carbon steels of the type of steel H usually contain about 0.65 per cent manganese, which results in a comparatively high core hardness. Had the 0.35 carbon steel H contained but 0.20 per cent manganese, there would have resulted a decidedly more rapid drop in core hardness and a much greater error in the Brinell reading.

The Rockwell test will also be affected and show low readings when the permanent deformation under an impression reaches steel of variable hardness. However, the major part of the pressure is taken up by steel of uniform hardness near the base of the impression, while only the comparatively small area of the rounded apex reaches steel of variable hardness, and therefore the error at first is negligible.

The relative dimensions of Rockwell and Brinell impressions are shown in Fig. 12. It can be seen that the Brinell impression covers a relatively wide area, and consequently the permanent deformation will cover a wide area and so almost immediately affect Brinell readings when steel of variable hardness is reached.

However, neither Rockwell readings obtained by cutting a section, or readings obtained by grinding from an outside surface will represent the true hardness when steel is rapidly changing in hardness on reaching the critical rate of change (the steep-slope portion of the curves of Fig. 12). The readings obtained by grinding from an outside face down will be affected as just described. The Rockwell impression has an appreciable width, and therefore will be spread over steel of variable hardness over the critical range and so an error will be introduced. However, some idea is obtained of hardness penetration, and with a fair degree of accuracy, by the methods described.

On Fig. 5, in the first part of this article, are shown a group of shallow-hardening steels. The causes of the variations in Brinell readings are now evident. In the case of steels E, F and G, very little error is introduced at a drawing temperature of 350 deg. F., because the Brinell deformation lies within steel of uniform hardness. As the temper of the steel is drawn, and the Brinell

Table V—Conversion Table for Deep-Hardening Steels, Rockwell "C" to Brinell

Rockwell "C"	Brinell	Rockwell "C"	Brinell	Rockwell "C"	Brinell	Rockwell "C"	Brinell
69.0	754	56.5	584	44.0	426	31.5	299
68.5	747	56.0	577	43.5	420	31.0	296
68.0	740	55.5	570	43.0	414	30.5	291
67.5	733	55.0	563	42.5	408	30.0	288
67.0	725	54.5	556	42.0	403	29.5	283
66.5	719	54.0	550	41.5	397	29.0	280
66.0	712	53.5	543	41.0	391	28.5	276
65.5	705	53.0	537	40.5	386	28.0	272
65.0	698	52.5	530	40.0	380	27.5	268
64.5	692	52.0	523	39.5	375	27.0	265
64.0	685	51.5	516	39.0	370	26.5	262
63.5	678	51.0	510	38.5	365	26.0	258
63.0	671	50.5	503	38.0	359	25.5	255
62.5	665	50.0	498	37.5	354	25.0	252
62.0	658	49.5	492	37.0	349	24.5	248
61.5	651	49.0	486	36.5	344	24.0	246
61.0	644	48.5	480	36.0	339	23.5	242
60.5	638	48.0	474	35.5	335	23.0	239
60.0	631	47.5	468	35.0	330	22.5	236
59.5	624	47.0	462	34.5	325	22.0	234
59.0	617	46.5	456	34.0	321	21.5	230
58.5	611	46.0	450	33.5	316	21.0	228
58.0	604	45.5	444	33.0	312	20.5	226
57.5	597	45.0	438	32.5	307	20.0	224
57.0	590	44.5	432	32.0	304		

deformation begins to extend into steel of variable hardness, an error becomes evident which assumes a maximum phase and then diminishes and finally disappears as steel of uniform hardness throughout the section is obtained with higher drawing temperatures.

It may be added that an 0.80 carbon steel sample 1x1x1¼ in., when hardened at 1,420 deg. F., also showed an error corresponding to one Rockwell number. With this particular sample, after drawing to 375 deg., Brinell readings taken ¼ in. from an outside edge showed a uniform hardness of 647, whereas Brinell readings at the center varied from 617 to 622. Here we get low readings in the center and correct readings ¼ in. from an outside edge. The explanation is that there is steel of uniform hardness to the necessary depth to give correct Brinell readings at a distance ¼ of an in. from an outside edge, whereas readings at the center of a test piece of 0.80 carbon steel develop an error due to the Brinell deformation reaching steel of variable hardness. Samples of 1.30 carbon steel were heated to 1,475 deg. F., and brine quenched. Even this comparatively high hardening temperature failed to eliminate the Brinell error completely.

From the foregoing it can be seen that a Brinell reading, when affected by a soft core, will not represent the true surface hardness. In order to ascertain the true surface hardness in steel of variable hardness, it will be necessary to use a test piece thinner than the critical diameter, or size of the steel in question, so as to obtain steel of uniform hardness throughout the section. Steel H (0.35 per cent carbon) when tested on a section 1 in. in diam. and ⅜ in. thick, showed a negligible error. Steel E (1.20 carbon), however, shows an error on a section as thin as 0.300 in. and it would be necessary to further decrease the thickness to eliminate the same.

It is a well known fact that Brinell readings are affected by varying the time of application of the load, and therefore the time element has been more or less standardized at 30 sec. Nothing has been done in this regard with the Rockwell test. It is quite evident, by referring to Fig. 13, that variations in the time of application of the major load can cause an error of one Rockwell number on steel with a hardness reading of C-22.

The results obtained in this investigation can be duplicated quite accurately if the precautions as to heat-treating and grinding are followed, and provided that the time element is considered for both Rockwell and Brinell testers as 30 sec. All machines must be carefully calibrated. In calibrating the Rockwell machine, it would be necessary to get two, or better three, standard test blocks of different hardness values from the Wilson-Maeulen Company, following their instructions on the use of the same. If a curve be plotted using the difference between the hardness values obtained, and those of the test block, the necessary Rockwell hardness corrections can be made to get accurate results. Care should be taken, in making the Rockwell readings, that the test piece does not move between the application of the major and minor loads, as otherwise a serious error will be introduced. This is a frequent cause of error in taking Rockwell readings.

Conclusions

1. A single conversion table can be used for all steels, irrespective of analysis, which harden uniformly to a depth greater than the gage limits shown in Fig. 9. This includes all alloy steels with the exception of a steel alloyed with vanadium only, as such an alloy steel develops hardness-penetration characteristics similar to those of a plain-carbon tool steel. In other words, when steel hardens deep enough so that both Brinell and Rockwell impressions are well within the steel of uniform hardness, a single conversion table can be used.

2. Most of the carbon tool steels, when hardened slightly above their critical temperatures, do not harden deep enough to get correct Brinell surface-hardness readings. In such cases the Brinell test must be made on a section thin enough to insure uniform hardness throughout.

3. The Brinell test, when made on carbon steels of shallow hardness-penetration properties, is not representative of the true surface hardness of such a steel, and in all such cases will be lower than the actual surface hardness. The soft core of this type of steel is the cause of this error. Permanent deformation of the material beneath the impression allows the ball to sink deeper into the steel, and to give an apparent surface hardness reading which is lower than the real hardness.

4. The Rockwell test, because of the shallow penetration of the indenter, is not usually affected by a soft core, the exception being for some steels that have been case hardened.

5. Both the Rockwell and Brinell indenting tools change the hardness of steel in making a test. For high Rockwell readings, the increase in hardness due to making a Rockwell impression is much greater than the increase in hardness due to the cold work performed by the Brinell ball on the same steel. The rounded apex of the Rockwell cone is primarily the cause of this.

A limited number of steels of the shallow-hardening type have been investigated, and there is a possibility that even greater errors would show up in other steels than have in those investigated. As a matter of interest to metallurgists, it might be well for others to investigate microscopically the area of grain deformation around Rockwell and Brinell impressions on various steels.

Table VI—Conversion Table for Deep-Hardening Steels, Brinell to Rockwell "C"

Brinell	Rockwell "C"	Brinell	Rockwell "C"	Brinell	Rockwell "C"	Brinell	Rockwell "C"
755	69.0	620	59.2	485	48.9	350	37.1
750	68.7	615	58.8	480	48.5	345	36.6
745	68.3	610	58.4	475	48.1	340	36.1
740	68.0	605	58.1	470	47.7	335	35.5
735	67.6	600	57.7	465	47.4	330	35.0
730	67.3	595	57.4	460	46.8	325	34.5
725	67.0	590	57.0	455	46.4	320	33.9
720	66.6	585	56.6	450	46.0	315	33.4
715	66.2	580	56.2	445	45.6	310	32.8
710	65.8	575	55.8	440	45.2	305	32.2
705	65.5	570	55.5	435	44.5	300	31.6
700	65.1	565	55.1	430	44.3	295	31.0
695	64.7	560	54.8	425	43.9	290	30.3
690	64.4	555	54.4	420	43.5	285	29.7
685	64.0	550	54.0	415	43.0	280	29.1
680	63.6	545	53.6	410	42.6	275	28.4
675	63.3	540	53.3	405	42.2	270	27.7
670	62.8	535	52.9	400	41.8	265	27.0
665	62.5	530	52.5	395	41.3	260	26.3
660	62.2	525	52.1	390	40.9	255	25.5
655	61.8	520	51.8	385	40.4	250	24.8
650	61.4	515	51.4	380	40.0	245	24.0
645	61.0	510	51.0	375	39.5	240	23.2
640	60.6	505	50.7	370	39.0	235	22.5
635	60.3	500	50.3	365	38.5	230	21.4
630	59.9	495	49.8	360	38.1	225	20.3
625	59.6	490	49.4	355	37.6	220	19.0

Causes and Effects of Wear on Gear Teeth

By Earle Buckingham

Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Test data indicate that with clean oil and tooth loads below the compressive fatigue limit of the material gear teeth will run indefinitely without appreciable wear

As a result of the completion of a series of tests at the Massachusetts Institute of Technology, together with the results of other wear tests reported by E. R. Ross of the Warner Gear Company, Prof. C. W. Ham and J. W. Huckert of the University of Illinois, and Prof. G. H. Marx and L. E. Cutter of Stanford University, we are now in a position to trace the progress of wear on gear teeth and to identify, with a responsible degree of certainty, the causes and effects of this wear phenomena. Wear on gear teeth is of three types: First, pitting which usually is most pronounced at the pitch-line area of the gear teeth; second, abrasion which usually takes place on the faces of the teeth of the driving gear and flanks of the teeth of the driven gear; third, cutting which takes place on the flanks of the teeth of the driving gear.

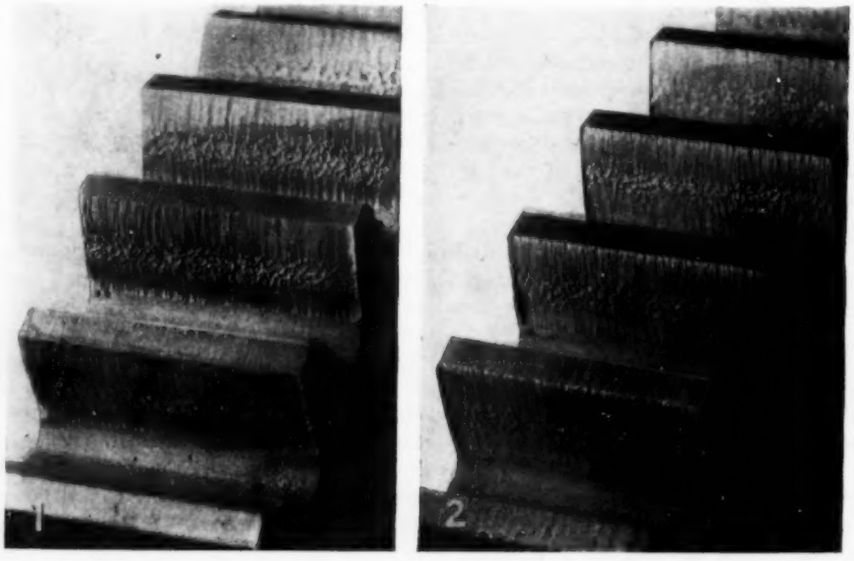


Fig. 1 — The results of abrasive wear on the face and cutting and abrasion on the flank of a cast-iron gear of 4 D.P. after it has been run at a pitch-line speed of 1,270 ft. per min. for 326,000 revolutions. The area at the pitch line has been pitted. Fig. 2 — Similar conditions of wear are shown on the mating gear

Pitting is the result of the high compressive stresses set up by the contact of the curved profiles of the teeth under load. The intensity of these stresses and methods for their determination were discussed in an article on page 777, Vol. 64, of the *American Machinist*. When these compressive stresses exceed the ultimate strength of the material, small particles of the material are sheared out of the surface. The shape and size of these particles depend upon the physical characteristics of the material. With some materials they are very fine, while with other materials these particles are flaky and of appreciable size. Probably this pitting occurs at the pitch-line area because the action here approaches pure rolling and also because a single pair of teeth are usually carrying the full load at this phase of the tooth mesh.

Incipient pitting is almost always present on heavily loaded gears. This pitting progresses to a limited extent and then ceases. This kind of pitting is probably due to the shearing out of the weaker or unsound particles of the material. When all of these have been removed, this pitting ceases unless the loads create stresses beyond the fatigue limit of the sound material. Such incipient pitting should never be a cause of alarm: It appears early in the life of the gears and soon ceases to progress further. Pitting is the result of compressive fatigue. With ductile or plastic materials (as measured by their ability to be cold-worked), the operation of the gears under load tends to cold-work the gear tooth surfaces and to raise their physical properties. Thus the stresses required to cause destructive pitting on such cold-worked surfaces may be very much higher than the ultimate strength of the material in its original condition. For this reason a bronze gear of lower physical properties but greater ductility often proves to be a better wearing gear than one of a bronze with higher physical properties but of lesser ductility.

Abrasion is caused by the failure of the oil film to keep the surfaces of the gear teeth separated, or by the presence of foreign matter, such as grit or metallic particles in the lubricating oil. It results in scratches or grooves running vertically from the pitch-line area to the tops and bottoms of the tooth profiles.

Cutting takes place when, either because of wear, errors in tooth profile, or deformation of the teeth under load, the entering tip of the tooth of the driven gear makes contact or interferes with the flank of the tooth of the driving gear. This entering tip travels in a looped path in relation to the driving gear—the name of this

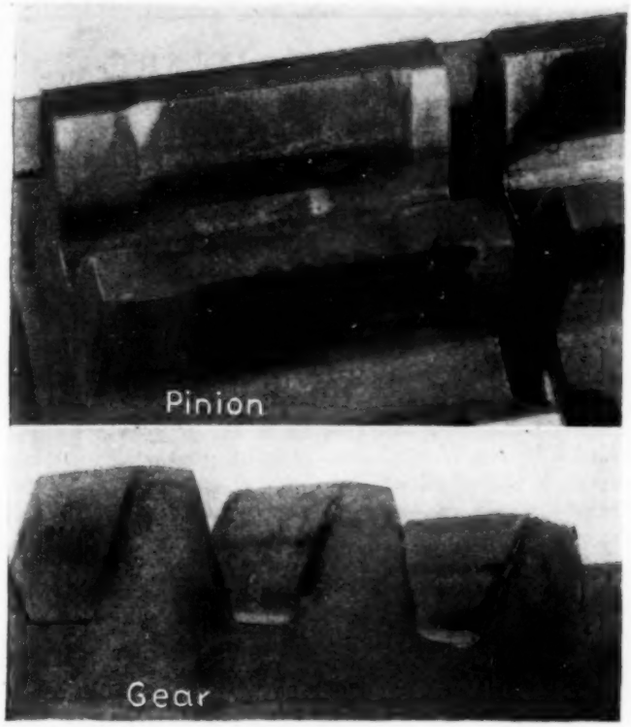


Fig. 3—Ridges produced in the teeth of an 18-tooth steel pinion and the corresponding hollows in the teeth of a 72-tooth cast-iron gear due to the material of one being more plastic than that of the other

curve being a trochoid—and is practically tangent to the profile of the flank of the tooth of the driving gear so that a very slight displacement because of wear or deflection will permit actual contact to exist. When this condition is present, the flank of the driving gear tooth will tend to wear concave, as this is the form of the trochoidal path, thus resulting in a worn tooth form of double curvature. This cutting is another form of abrasion and is usually more severe than that on the face of the driving tooth.

On excessively worn gears, all three types of wear have been involved. A close observation of gears under test indicates that the wear progresses as follows:

First pitting develops because of compressive fatigue and results in the shearing out of small particles of the material. These particles are carried in the lubricating oil and start abrasive wear on the faces of the driving teeth and flanks of the driven teeth. When this wear is sufficient to permit the entering tip of the tooth of the driven gear to touch the flank of the tooth of the driving gear, cutting starts. This cutting action increases the amount of metallic particles in the lubricating oil and thus accelerates the abrasive wear.

Professor Ham reports that the wear is very rapid at first and then practically ceases or is retarded for a comparatively long period, and that with continued running, this cycle of wear phenomena is constantly repeated. The probabilities are that pitting occurs first, releasing particles of the metal which would be responsible for the abrasion, and then this wear results in contact between the tip of the entering tooth of the driven gear and the flank of the driving tooth with the resulting cutting and further abrasion. After the cutting is sufficient to clear a free path for the tip of the entering tooth and the particles of material have worked themselves free of the active profiles, further wear does not take place until more pitting occurs because of the compressive fatigue of the material, which may have received a thorough cold-working. Then this cycle is repeated.

This same repeated phenomena is apparent also in tests for endurance of bevel gear rear axle drives for automobiles. When the temperature of the oil in the case is recorded as a measure of the operating conditions, this temperature rises to a maximum and then falls somewhat and remains practically constant for a considerable period of time. Then it rises again to another maximum and falls again as before. Sometimes the temperature during its constant period is lower after the successive rapid rises, and sometimes it is higher. The rises are probably due to the periodical wear phenomena, while the change of the temperature during the intermediate periods is probably due to the condition of the worn teeth, including both the smoothness of the surfaces and also their relative accuracy as regards the conjugate tooth action between them.

In Fig. 1 is shown a photograph of a 30-tooth, 20-deg. involute, cast-iron pinion of 4 D.P. after a run of about 326,000 revolutions at a pitch-line speed of 1,270 ft. per min. under a load of 1,867 lb. per in. of face. Here may be seen the results of abrasive wear on the face and cutting and abrasion on the flank, separated by the pitted surface at the pitch-line area. This pinion was meshed with the 60-tooth cast-iron gear shown in Fig. 2. This shows similar conditions of wear as for the pinion.

When the materials used for the pinion and gear are different, particularly if one material is more plastic or ductile than the other, the wear often results in a hollow at the pitch-line area of the gear made of the more crystalline material, caused by its pitting, and a corresponding ridge on the tooth of the gear made of the more plastic material. This ridge is caused by its cold-working

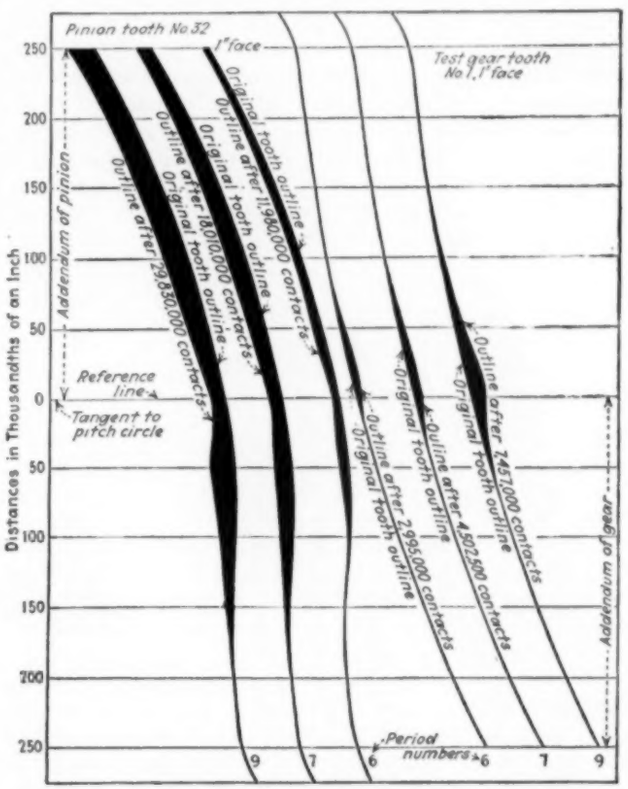


Fig. 4—Diagram showing the progressive wear on the tooth profiles of the gears shown in Fig. 3 (Ham and Huckert)

into the hollow of the mating tooth. This action is shown in Fig. 3, where a ridge is present on the 18-tooth steel pinion and a hollow exists on the mating 72-tooth cast-iron gear. These gears are also of 4 D.P. Fig. 4 shows the progressive wear of the outlines of these gear tooth profiles.

The evidence seems to indicate that *for metal gears, if clean oil only is present and the tooth loads are below the compressive fatigue limit loads of the materials so that pitting will not start, the gear teeth will run indefinitely without measurable indications of wear.* In other words, as pitting seems to start the wear cycle, if pitting is avoided, the wear cycle will also be avoided.

Where non-metallic pinions are used, the only type of wear apparent, when grit and dust are absent, is cutting. This takes place because of the relatively large amount of deformation on these materials which permits the corner of the entering tooth of the metal gear to scrape the flank of the non-metallic pinion. This condition can

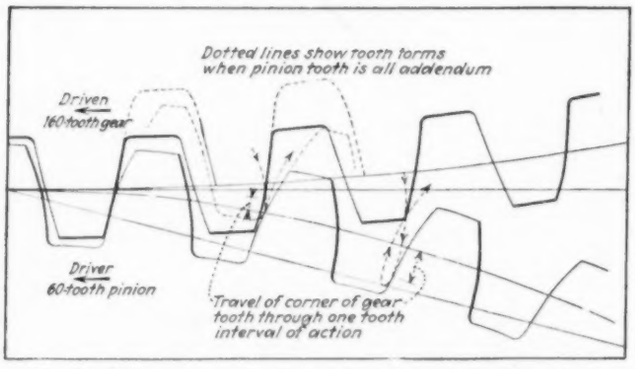

Dotted lines show tooth forms when pinion tooth is all addendum
Driven 160-tooth gear
Driver 60-tooth pinion
Travel of corner of gear tooth through one tooth interval of action

Fig. 5—Effect upon the lines of action of the tips of the entering teeth when a non-metallic pinion is made all-addendum in order to eliminate cutting action

be minimized or eliminated by increasing the addendum of the non-metallic pinion as much as possible up to a maximum of all-addendum. In this last case, the path of the corner of the metal gear will be an epicycloid. These paths of the tips of the entering teeth of the metal gear are indicated in Fig. 5, which shows the conditions that exist between a 60-tooth pinion and a 160-tooth gear of 14½-deg. involute tooth form.

Co-operation or Planning
Discussion

By Morton Schwam

THE question of co-operation or planning as raised by Mr. L. B. Jones on page 273, Vol. 70, of the *American Machinist,* can be answered by saying that there should be co-operation at the time the jobs are scheduled. By holding a conference of department heads and all other interested parties before a job is started, each operation will be scheduled with the knowledge of the various foremen, and each foreman will know just when to expect to get the work.

However, co-operation loses its significance if one foreman tries to rush the foreman of another department just because he is ready to take on more work. With the method of scheduling jobs before they are started in the shop, each job is given a priority, and each foreman pushes the job having a higher priority just a little harder than the others, knowing that the next department is waiting to carry the job on.

SEEN · AND · HEARD

By John R. Godfrey

Oiling machines in motion — Oil and boring fixtures—Oiling parts with a spray gun

ONE advantage of lubricating a machine from a central point is that the oil or grease can be introduced while the machine is in operation. There seems to be little question as to oil or grease working into a bearing better while it is in motion, yet in many cases, it is decidedly dangerous for men to oil individual bearings with the machine running. This feature alone is attracting the attention of engineers responsible for maintenance of machinery of various kinds.

* * * *

"A DROP of oil in time saves dollars," might well supplant the "stitch in time" adage so far as manufacturing is concerned. A recent example was seen in the cylinder line of a large motor building shop. One of the boring bars had siezed in its bushing. And though the other seven bars, and all the rest of the machines in the whole line-up of perhaps forty operations were O.K., the entire production line was at a standstill for hours. For it is no easy job to "unstick" a bar in a close-centered group of six or eight, with a cylinder block in the fixture and the bar part way in its bore.

Tool designers will do well to pay careful attention to such contingencies as this, not only in providing for lubricating boring bars in their guide bushings, but in so designing the fixture that boring bars can be readily disconnected and any bushing removed without tearing the whole fixture apart. For while boring bars seldom stick in their bushings, it costs a barrel of money when they do. Tying up a production line is expensive when it means ten cars, more or less, every hour, for which the sales department does not get their money.

* * * *

SPEAKING of oil—in few places is it more important than when working parts of machines are being assembled. A bearing put together dry, may cut and be ruined before oil gets to it in the regular working of the machine. It only needs a little but it needs that little mighty bad.

In assembling pistons into cylinders it is very common practice to use a squirt can to put oil on each cylinder wall and then smear it around with the hand or a small wiper. Some use a swab, which is easier on the hands, but neither are dead sure to distribute oil all over the surface.

In the Franklin plant they use a spray gun similar to that used in spraying paint or lacquer in the body shop. The gun holds perhaps two quarts of lubricating oil and is easily handled. Just before putting the pistons in the cylinder the assembler picks up the gun and sprays the inside of each cylinder. He also sprays the pistons and the paper gaskets between the cylinders and the crankcase. It takes less time than any other method and insures a thin but uniform coating of oil on all the surfaces before they are put together.

Methods of Hardness Testing

Vickers Diamond Pyramid Machine

The Vickers Pyramid Hardness Testing Machine measures hardness by determining the depth of penetration of a diamond indenter under a load. The diamond indenter is particularly adapted to accurate measurement of materials of a high degree of hardness because of its small distortion under load. It is also valuable for the measurement of the hardness of thin sheets, because of the accuracy with which the small impressions may be read. The small size of the impression made by the machine does not mar the specimen, and is therefore useful where readings are to be taken to find soft spots in the metal.

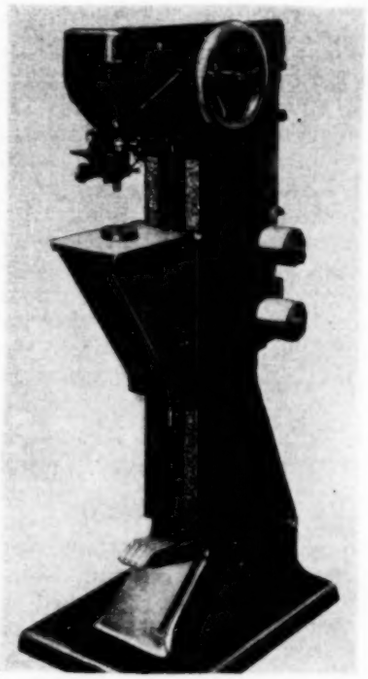


Fig. 1—The Vickers Pyramid Hardness Testing Machine

The diamond indenter is accurately cut and polished to the form of a square-based pyramid, whence its name, so that the impressions are square. The load is light, varying from 5 to 120 kilograms (about 11 to 264½ lb.), according to requirements, and is applied and removed automatically. The pyramid shape of the indenter results in impressions in the work which are well defined, and, being square, can be measured across the diagonals with considerable accuracy; and the impressions are geometrically similar, irrespective of depth.

When taking the usual type ball tests, it is customary to keep the size of the impression between one-quarter and one-half of the ball diameter, with three-eighths of the ball diameter as the ideal. The included angle of the diamond indenter, 136 deg., was chosen to give a similar angularity with the result that the readings are identical, in the lower regions of hardness, with the readings obtained by means of the usual steel balls. Between readings of 500 and 600, the steel ball begins to give slightly lower readings than the diamond, the tendency increasing until it becomes very pronounced at Brinell readings of 600 to 800. The explanation given for this is that the steel ball distorts under the high loads necessary in testing very hard materials, while the diamond shows no appreciable distortion. In order to distinguish between the Brinell numerals obtained with the 136-deg. diamond pyramid and those with the steel ball, the former are quoted as "degrees Vickers Pyramid Numeral," abbreviated as deg. V.P.N.

The internal mechanism of the machine shown in Fig. 1 consists mainly of a weight operated cam whose speed of rotation is controlled by an oil dashpot, and whose movement applies the load to the diamond indenter. The cam both raises and lowers the indenter, thus controlling the duration of the loading. After the mechanism has returned the diamond indenter, a depression of the foot pedal returns the cam and other mechanism to their original positions. In starting a test, movement of the straight starting handle releases the mechanism, and the test proceeds automatically, terminating with an audible click. A small buzzer warns the operator when work and indenter are not in the correct relation.

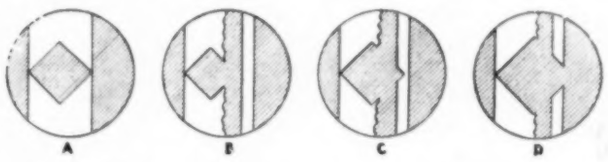


Fig. 2—How the impressions look through the eyepiece

The measuring microscope centers automatically, and is capable of measuring to 0.00005 in. It is arranged to be swung accurately into position over the impression. The impressions are read to knife edges, and readings are taken from a counter mounted on the side of the microscope. There are three knife edges, or cross hairs, in the eyepiece, one of the knife edges being fixed, another movable by means of a micrometer screw connected to the counting mechanism, and the third provided for rapid readings to specified limits. The left-hand corner of the impression is set to correspond to the fixed knife edge, and the movable knife edge adjusted to correspond with the right hand corner of the impression. The whole then appears as shown at *A* in Fig. 2, and the reading is taken.

When it is desired to determine whether work conforms to specified hardness limits, the third knife edge is set to correspond with the maximum limit of hardness, and the movable edge to the minimum limit of hardness. When taking readings it is only necessary to set the fixed knife edge to the left-hand corner of the impression in the ordinary way. At *B*, *C*, and *D*, of Fig. 2 are shown the manner in which impressions appear in the eyepiece, the material at *B* being too hard, that at *C* of correct hardness, and the material at *D* too soft. About 200 tests per hour can be made.

For the data given we are largely indebted to The Riehlé Brothers Testing Machine Company

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IDEAS · FROM · PRACTICAL · MEN

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

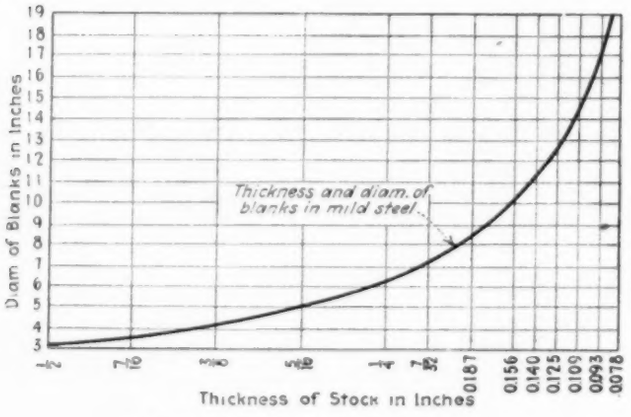
A Capacity Chart for Punch Presses

By Frank Mossberg
President and Gen'l Manager, Mossberg Pressed Steel Corp.

After twenty years experience in operating presses, I am satisfied that there is no other machine tool subjected to the abuse that a punch press is. This abuse is not the result of carelessness but because the foreman and die-setters have no information as to the capacity of the press, and consequently pay no attention to the size of the job they do on it.

If it were possible to install an overload or breakpin device, much of the abuse might be prevented, but we have not found this practical.

To take care of management's share of the responsibility, we have made up a capacity chart for each individual press. As shown in the illustration, it gives the range of blanks that can be cut on a given press, both as to diameter and thickness, and the relation between diameter and thickness.



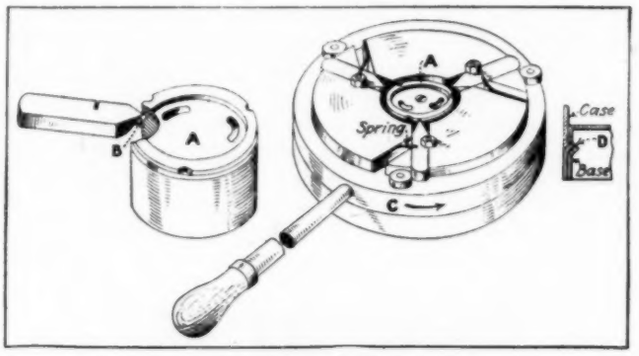
A capacity chart for punch presses

Our company operates presses with capacities from 1,400 tons down to less than one ton. Since we have adopted the diagram, we have eliminated the breaking of presses, entirely.

Fixture for Sealing Automobile Instruments

By Charles H. Willey
Asst. Plant Supt. Hoyt Electrical Works

In sealing automobile instruments, the bases and cases are pierced in three places after assembly, forming tongues through the walls of both parts and locking them together. For this operation, the fixture shown in the illustration was designed. Its operation is as follows:



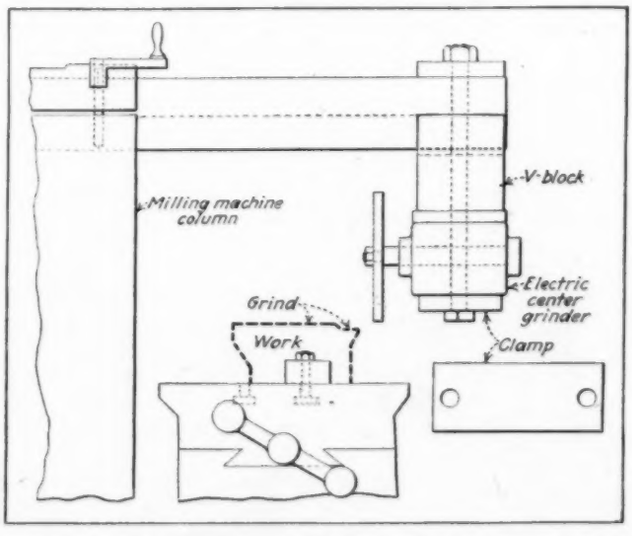
Sealing fixture for automobile instruments

The cases and bases to be sealed are placed over the plug *A*, which has an annular V-shaped groove, as indicated at *B*. The three pointed-punches are forced inwardly by the rollers as the ring *C* is rotated in the direction of the arrow. The punches pierce both the case and the base, forcing small parts of the walls inwardly, as shown at *D*. The slots in the top of the plug *A* permit the instruments, together with their studs, to be rotated so that the indentations made by the punches come opposite the clearance notches, thus permitting their removal.

An Improvised Surface Grinder

By Elliott B. Kibbey

Any man who operates a small jobbing shop realizes the many obstacles that often confront him, obstacles that ordinarily would not require a second thought in larger and well-equipped shops. We had a breakdown



Grinding on a milling machine

job to repair for a knitting mill, and like most breakdown jobs it had to be rushed as much as was possible.

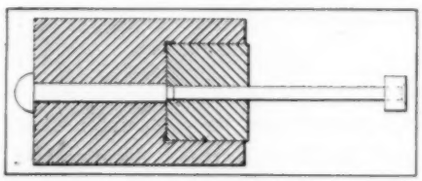
The majority of the machining operations went along finely, considering the many narrow slots in the work that tapped holes passed through. The top surface, however, required a smooth, ground finish. Not having a surface grinder, we clamped the work on the table of a milling machine, as shown in the illustration. We then clamped an electric center-grinder to the overarm of the machine, as per the illustration. Naturally, the grinding operation was not as fast as if it had been done on a surface grinder, but the improvised arrangement did the trick and made a good job.

Die for Heading Screw Blanks

By H. Zeebroeck
Antwerp, Belgium

We had an order to make a large lot of screws from 0.122-in. spoke steel, to be $\frac{1}{2}$ in. under the heads. In attempting to head the blanks in the heading machine, we found that the die-pin would not resist the pressure necessary to head such hard steel. We tried die-pins made of other kinds of steel, but they did not stand up any better than the first one.

Finally, we made a new body die and inserted a bushing at the rear end, as shown. The hole in the bushing was smaller than the one in the die and served to carry the ejector pin. In heading, the ends of the blanks were supported by the metal around the hole in the bushing, instead of by the die-pin as formerly. After this we had no further trouble and were able to head several thousand blanks before having to replace the bushing.



Heading die with bushing at rear end

Gage for Fitting Crown Brasses

By J. H. Hahn

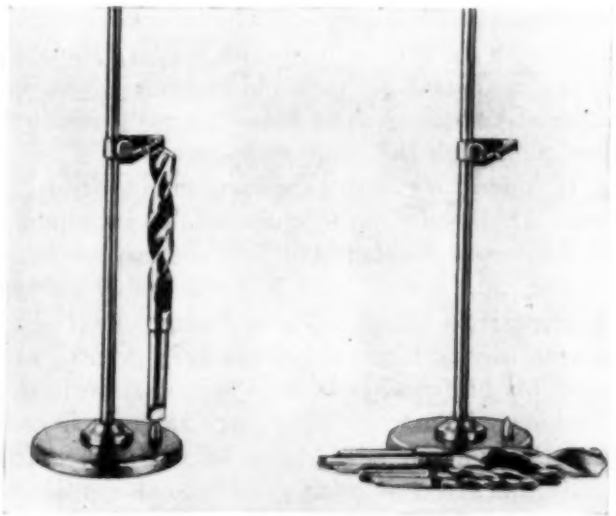
Many types of gages have been used for transferring the inside measurements of driving boxes to the crown brasses, all of them more or less complicated and most of them consisting of two gages, one for the inside of the box and one for the outside of the brass, the size being transferred from one to the other. In the illustration shows an assembly and details of the gage.

In taking the inside measurement of the box, the outside of the lug *A* is set flush with the end of the gage. The gage is then inserted in the box with the top of the lug *A* against the top of the opening. The ends of the wings are then brought into the notches where the ends of the crown brass fit, and the thumbnut *B* is tightened. For transferring the size of the opening in the box to the outside of the brass, the lug *A* is pulled out as far as it will go, the distance being equal to the thickness of the lug. The lug is then hooked over the top of the crown brass and lines are scribed at the top and along the lower edges and the ends of the wings. A circle drawn through the three outer points gives the size of the brass, while the lines scribed from the lower edges of the wings, give the angle and location of the ends of the brass where they fit into the notches in the box.

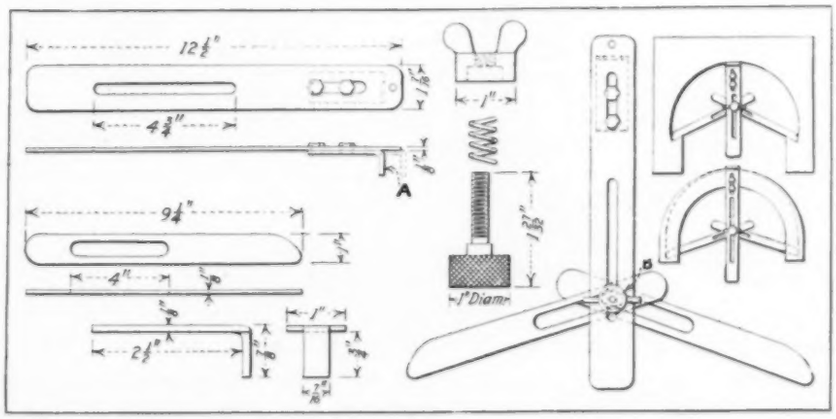
An Adjustable Drill Gage

By M. R. Leedy

In re-grinding drills it is desirable that the clearance back of the cutting lip be kept to 12 deg. As this holds good for all sizes of drills in general use, we made an adjustable gage for checking the lips of the drills we were re-grinding. The illustration shows the gage as it is used, and by itself. It is simple, yet practical. There are three essential parts, a turned steel base with a center threaded into it, a slotted round rod threaded into the center of the base and the angle gage which slides up and down, and can be clamped at any point on the rod by a knurled screw. There is a sliding adjustment on the angle gage, which can also be clamped, making it possible to hold a drill in position while checking the clearance. This gage has been in use for some time and we have noticed that our drills are holding up much better.



An adjustable gage for checking the angle of the cutting lips



Gage for transferring sizes of driving boxes to crown brasses

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Appropriations for Research in the Field of Mechanics

ANOTHER evidence of the voicelessness of the machinery industry has come to light through a plea for an additional appropriation for the "Testing Machine Fund" of the Bureau of Standards. The appropriation to this fund is used to carry on the work of the Engineering Mechanics Section of the Bureau, which involves the operation of the three large testing machines and the many smaller ones. This division also conducts calibration tests and considerable research.

The present appropriation is so inadequate that some of the work has been financed by transfer funds from other Government agencies, and by the research associates located at the Bureau and supported by various industries. It is estimated that the amount realized and expended from industrial contributions is from ten to twenty per cent more than the regular appropriation.

If American industry thinks well enough of the work of this division to contribute to its support in the proportion indicated, is it not reasonable to assume that the division is entitled to a larger appropriation from the Federal authorities? The reason why an increase has not been granted can probably be found in lack of organization in the machinery industries. They have made their contributions individually but they have not demanded Government action with a voice loud enough to be heard.

Is the Highly Skilled Artisan Disappearing?

MUCH confusion exists as to the disappearance of skilled mechanics or artisans not only in the machine building industries but in most others where machines are reducing the amount of heavy labor and increasing output. And, as usual, many well-intentioned persons are misinterpreting the effect of the change both on the worker and his product.

It is practically true that the old-time mechanic who could produce a surface that was flat by old-time standards has disappeared. It is equally true that the tail disappeared from our ancesters when its use was no longer necessary. Of what use would even the most skillful filer be today when our modern grinding machines can produce a much better surface in an infinitesimal part of the time?

With few exceptions, modern machinery requires more skill than ever before, if we consider the initiative and knowledge spent in designing, building and keeping it in operation. Much machinery, it is true, demands but little skill to operate or feed it, as compared with that needed when machines were crude and poorly built. For we must not overlook the fact that in spite of all our talk about the skill of old time artisans, machines of all kinds today are much more accurate and more efficeint. But there is apparently no dearth of men and women whose mental equipment seems to fit them better for machine operators than for anything else. In an earlier generation they would have been laborers or charges on the community.

That we lack an adequate supply of both skilled and semi-skilled workers, cannot be denied. Not because of any lowering in skill on the part of toolmakers and the like, but rather because we need so many more equipped with an even greater skill than ever before. All credit to the artisans who produced marvelous mechanisms and machines with inadequate equipment, but they would find it difficult to equal the more accurate workmanship demanded by our present-day needs.

Limiting Conferences

CONFERENCES are becoming a real problem in the conduct of business. While many are fruitful and productive of good results, some officials are asking themselves, and others, as to whether the time taken is always well spent. Men are beginning to seek ways of reducing rather than increasing the number of conferences held.

That modern business requires occasional, even frequent, getting-together of those responsible for results, can hardly be questioned. The trouble is that too many men are asked to participate and that too much time is wasted in non-essential matters. Unless a conference is handled by an experienced chairman it can easily waste more time than is compensated for by the benefits obtained.

Some of those who are interested in securing results at a minimum of time feel that limiting the number attending the conference as much as consistent, and having a definite program whenever possible, are steps in the right direction. They feel that, to be profitable, conferences must be planned as carefully as any other phase of business activity.

Hanchett Nos. 700 and 800 Vertical Production Surface Grinders

HARDENED steel dies, gages, tools, chasers, shear blades, and numerous other parts may be ground accurately and rapidly on the Hanchett Nos. 700 and 800 vertical production surface grinders, announced by the Covel-Hanchett Company, Big Rapids, Mich. The chief differences between these models are that the No. 700 is lighter than the No. 800, and that the smaller model is equipped with hand feeds ordinarily.

Each machine has its base made from a single casting of box-type construction. Similar construction is used for the arm of each model, and the pivoting end of the arm is bored for Timken roller bearings. The arm is carried on a vertical post at the rear. A segment and roller are provided near the wheel to insure ease of movement and rigidity. Drop-forged steel spindles and armature shafts are used on both models, deep-groove ball bearings being fitted on each. No clamps are used for holding the grinding wheel on the spindle mounting, and the wheels may be changed quickly. The grinding wheel is surrounded by a heavy guard securely held to the wheelhead. This guard is adjustable and furnishes adequate protection in the event of wheel breakage.

With regard to the capacities of the Nos. 700 and 800, the former will grind work either 6x10 in. or 4x16 in., whereas the No. 800 will take care of work 7x12 in. or 5x20 in. on the rectangular table or grind the largest pieces that can be mounted at each radial T-slot of the 27-in. circular table. Rectangular tables 8x20 in. and 10x26 in. can be fitted on the respective sizes. Circular tables up to 27 in. in diam. and operated by hand or power can be obtained for the No. 800 model. Where special cases demand it, a circular hand-operated table can be applied to the smaller unit. Segmental or cup wheels 10, 12 and 14 in. in diam. can be employed by the No. 800 and 5-, 9½- and 10-in. ring or cup wheels can be used by the No. 700. Spindle speeds for the larger machine are 1,250 and 1,800 r.p.m., and those for the lighter No. 700 are 1,800 and 3,600 r.p.m., except where 25-cycle current is used.

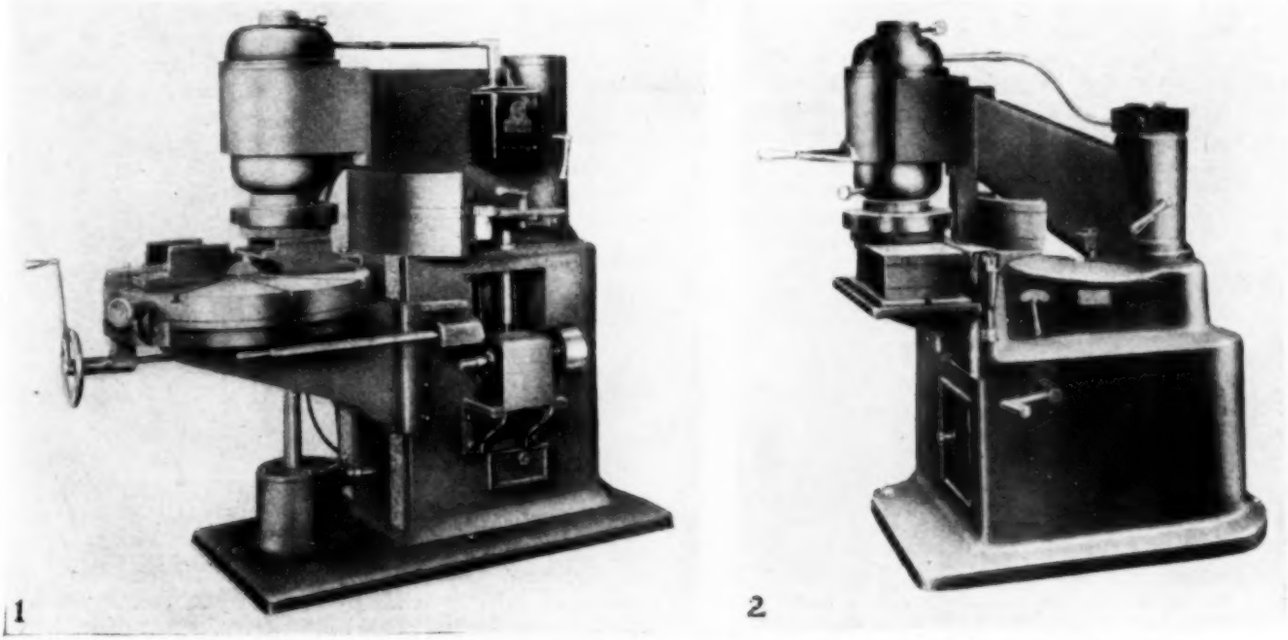
The table on the larger machine has vertical power feed and the rate of travel of the wheel over the work is from 15 to 35 ft. per min. Vertical adjustment of the wheel can be furnished. The smaller unit also has vertical feed for the table. The longitudinal feed is not required, as oscillation of the wheel over the work accomplishes this more effectively. The arm on the large machine swings on a 30-in. radius, and may be operated by power or hand. The wheel of the smaller machine may be swung by hand on a 24-in. radius.

Coolant is furnished the wheels of both machines in sufficient quantity to keep the work clean and keep the dust down. Standard equipment includes a grinding wheel guard, necessary wrenches, wheel dresser, and all electrical equipment, except a magnetic chuck and generator. The magnetic chuck may be furnished to suit, and, where d.c. current is not available, a small d.c. generator can be supplied.

The floor space required by the Nos. 700 and 800 grinders, respectively, is 22x28 in. and 24x50 in., the first being 55 in. high and the second 50 in. high. The weights are 1,150 and 2,950 lb. net, respectively.

"Red Band" Lift-Truck

An improved lift truck designated as the "Red Band" has been placed on the market by the Barrett-Cravens Company, 1328 W. Monroe St.,



1 2

Fig. 1—Hanchett No. 800 Vertical Production Surface Grinder. Fig. 2—The No. 700 model equipped with a rectangular table

"Red Band" Lift Truck

Chicago, Ill. According to the manufacturer, the truck will give 25 per cent easier lift than previous models, while permitting 50 per cent faster operation. It is of all-steel construction with such features as a roller-bearing latch catch, spring handle hold-up, Hyatt bearings, and an Alemite lubricating system. A 5-in. turntable has been incorporated in the design and 3-in. king bolts are now used. The frame is made of manganese steel.

"Ideal" Fuse Pullers

Four sizes of fuse pullers made up of laminated horn fiber have been placed on the market by the Ideal Commutator Dresser Company, Sycamore, Ill. According to the manufacturer, these fuse pullers have plenty of jaw surface and sufficient mechanical strength to remove fuses from tight clips with a straight steady pull and complete safety, even though the fuse may be live.

The "Midget" size is built up of three laminations and is 5 in. long.

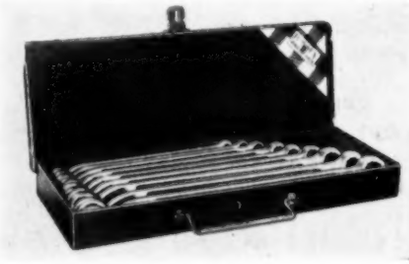
"Ideal" Fuse Puller

Gripping jaws are provided on one end and a screw driver on the other. The device is suitable for handling small fuses and grid leaks from $\frac{1}{4}$ to $\frac{1}{2}$ in. in diam. and small screws. The "Pocket" size, having five laminations, is $7\frac{1}{2}$ in. long, and is used for pulling fuses rated up to 200 amp. at 250 volts and from 1 to 100 amp. at 600 volts.

The "Giant" size has seven laminations and is 12 in. long. It is suitable for fuses rated at 100 to 600 amp. at 250 volts and 60 to 400 amp. at 600 volts. The last size "Jumbo" has nine laminations and is 20 in. long. It is a large powerful tool for handling fuses rated from 200 to 800 amp. at 250 volts and 200 to 600 amp. at 600 volts.

Bonney No. 33 Double-End Box Wrench Set

A set of double-end box wrenches, known as the No. 33, has been announced by the Bonney Forge & Tool Works, Allentown, Pa. The set contains nine wrenches with openings from $\frac{7}{16}$ to $1\frac{3}{8}$ in. all in an attractive metal carrying case. The wrenches are made with double hex-

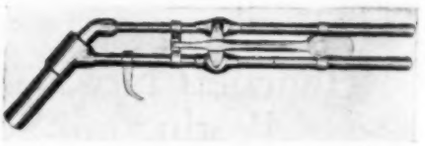


Bonney No. 33 Double-End Box Wrench Set

agon openings allowing secure gripping of nuts with very little handle movement. They are thin and light in weight, and are particularly useful for work in close quarters. These wrenches can also be purchased individually, if desired.

"Torit" Automatic Gas-Air Torch

An automatic torch known as the "Torit" has been placed on the market by the St. Paul Welding & Manufacturing Company, 174 West Third St., St. Paul, Minn. Two valves, one for city gas and the other for compressed air, are provided, and they are both operated simultaneously by a hand lever. The city-gas valve is so constructed that once the torch is lighted a small pilot continues to burn when the lever control is released. With this arrangement the torch is put into operation with hand pressure on the lever, which opens up both the city gas and the compressed air. Releasing the lever closes the air valve and reduces the flow of city gas to just enough for the pilot light. By the use of this construction a large saving in gas and air consumption is made.

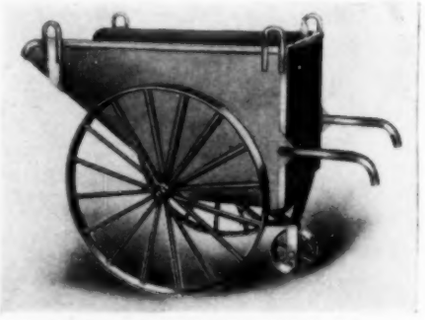


"Torit" Automatic Gas-Air Torch

Pittsburgh Roller-Bearing-Equipped Shop Truck

Although primarily designed for use as a nail buggy, the roller-bearing-equipped shop truck illustrated, which has been placed on the market by the Pittsburgh Producers Supply Company, Pittsburgh, Pa., is suitable for transporting heavy, loose material in bulk, such as machine tool turnings, small castings or small metal parts. The truck has a rated capacity of 1,500 to 2,000 lb., and the dimensions are: Length, 36 in., width, 24 in., and depth, 24 in. at the deepest point. It is mounted on two 30-in. wheels and one 8-in. pilot wheel having 2x$\frac{1}{4}$-in. treads.

Both wheels and the body of this truck are made entirely from steel sections welded together. The body is made of five sections of $\frac{1}{8}$ in. plate stamped to shape and lap welded at



Pittsburgh Roller-Bearing-Equipped Shop Truck

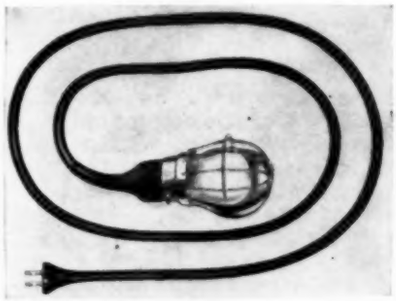
the corners. It is reinforced at both ends by means of 2x$\frac{1}{4}$-in. straps lap welded in place. Each corner of the body is equipped with a heavy bent rod bail, welded to the reinforcing

strap and to the body as well. These bails have been provided so that the truck can be lifted by a crane or hauled in a train. The handles of heavy tube sections are lap welded to the body.

All three wheels consist of welded parts. The spokes are made of pipe butt welded to the tread and hub, respectively, and staggered for greater strength. The hubs are made of seamless tubing, and the axle consists of a square bar lap welded to the body on both sides and machined at the ends. Each wheel is mounted on two Timken bearings, arranged to withstand the thrust loads occasioned by the passage of the truck over rough or uneven surfaces. The pilot wheel is supported on a stub axle, and is also furnished with Timken bearings. The turning pin is equipped likewise. By the use of these bearings at important points, one man can handle a loaded truck with ease when it is fully loaded.

"Unicord" Extension Lamp Set

An extension lamp set, known as the "Unicord," which is completely sheathed with soft rubber, has been placed on the market by the Resilient Terminals Company, Oakland, Calif. As shown in the accompanaying illustration, the set is inclosed in rubber from terminal to terminal, thus making it liquid proof and eliminating the possibility of the fine wires working loose under strain and causing a short



"Unicord" Extension Lamp Set

circuit. The lamp socket is heavily protected yet is short, and is handy for getting into small places. The shell of the socket and the contact points are cadmium plated to prevent corrosion. The Unicord set is made in standard lengths of 20, 25, and 30 ft. Additional lengths can be secured extra.

Brown & Sharpe Dresser for Stepped Grinding Wheels

A wheel truing device for stepped wheel dressing has been developed by the Brown & Sharpe Manufacturing Company, Providence, R. I., for use on the plain grinding machine described on page 221, Vol. 70, of the *American Machinist*. The dresser provides a quick and accurate means for sizing two different diameter wheels used for plunge cut grinding on two diameters of work at one setting. A feature is that it redresses the wheels in mimimum time and leaves the machine set for correct sizing of the work. None of the adjustments of the machine are disturbed.

The wheel-truing diamond nib is set at one end of the diamond slide, which is mounted at the front end of the truing device. At the opposite end of the slide is an adjusting screw for controlling the sizing of work. When in use, one end of this device is mounted between the work centers of the grinding machine and the other is clamped to a plate that is bolted to the swivel table of the machine. The device is mounted between the work centers without disturbing their adjustment, and it takes but slightly longer to mount the device than it does a piece of the work to be ground. A single quick-operating clamp holds it securely in place. In Fig. 2 a view is given of the dresser clamped to the way of the bed.

As will be noted in Fig. 1, the device has a rectangular opening in which is mounted a gage consisting of two hardened disks. The difference in the diameters of the two disks equals the difference in the diameters of the work to be ground. Should other diameters be desired the disks may be removed and reground, or replaced by another set having the required diameters.

The gage is so designed that it permits either of the two disks to come in contact with the diamond slide. A spring holds the slide constantly against either of the diameters of the gage with a uniform amount of pressure, thus relieving the operator of this responsibility. The handle clamps the diamond slide in either position.

The wheel having the larger diameter (for grinding the smaller diameter of the work) is trued with

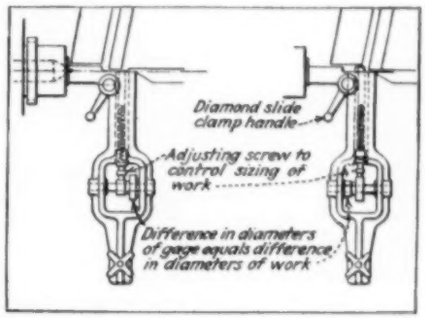
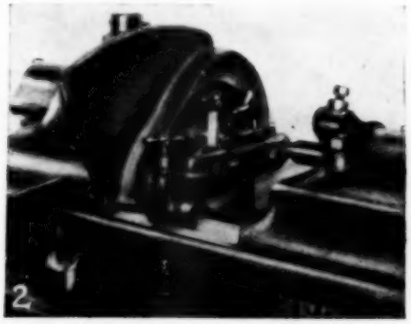

Diamond slide clamp handle
Adjusting screw to control sizing of work
Difference in diameters of gage equals difference in diameters of work

Fig. 1—The gages used on this Brown & Sharpe Stepped Wheel Dresser are ground and hardened tool steel disks either separate or integral

the gage in the position as shown at the left in Fig. 1, the smaller diameter of the gage being employed. For truing the smaller wheel (for grinding the larger diameter of the work) the diamond slide clamp is released, and the gage is moved toward the left until its larger diameter is brought in contact with the diamond slide, as shown at the right in Fig. 1. The slide is clamped in position while the wheel is being trued.

Once the adjusting screw of the diamond slide is set, it establishes the diameters of the work and needs



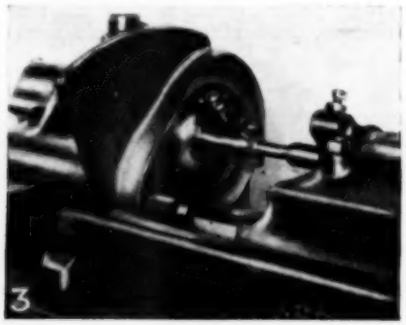


Fig. 2—The truing device in position for truing wheels. The fixtures on faceplate are not disturbed. Fig. 3—Showing the differences in diameter to which wheels may be trued

readjusting only as the diamond may wear. The wheels are correctly dressed with the wheelslide in the exact position it occupies when the work is to be finish ground to the correct size. The point at which the cross-feed stop was used for truing is correct for grinding, without further adjustment. In Fig. 3 is shown an example of the amount of stepping handled by the dresser. The lengths ground are shown also.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

A machine for straightening and cutting wire was patented, 1,703,885, by Frank C. Hutchinson, of Rutherford, N. J. The wire is drawn continuously into the machine through straightening rolls, and is cut off by a knife that travels along at the speed of the wire.

A continuous normalizing furnace patented, 1,703,943, by the Surface Combustion Co., Inc., has an elongated heating chamber with a series of geared shafts each driving a number of disks for pushing the work through.

A turret machine, patented, 1,704,032, and assigned to the New Britain Machine Co., has a U-shaped bed, multiple spindles, and a rotary turret supported longitudinally in a structure above the bed.

A patent, 1,702,520, on a hob-grinding machine, assigned to the Illinois Tool Works, covers a reversible grinder head for holding the wheel in contact with the hob, and a mechanism for rotating the hob and causing travel between the hob and the wheel.

An electric portable tool, patent 1,702,742, assigned to the Millers Falls Co., has a hollow handle connected with a casing inclosing the motor and a detachable cover plate for closing the casing and handle.

Materials

A method of welding broken castings was patented, 1,703,111, by Stephen J. Kniatt, of Philadelphia, Pa. It consists in notching the casting at the break, securing plates at each side of the notch, and connecting the whole with a weld.

An adhesive for wood and other materials was patented, 1,703,133 and 1,703,134, by Lawrence Bradshaw and Henry V. Dunham, of Bainbridge, N. Y. It contains a seed meal rich in protein, added starch, and an alkali.

An anti-friction metal was patented, 1,703,212, and assigned to the S. & T. Metal Co., Chicago, Ill. It is a lead-base alloy containing 1 to 5 per cent of tin, 0.1 to 1.0 per cent of calcium, 0.02 to 0.3 per cent of magnesium, and 0.02 to 0.1 per cent of aluminum.

A method of obtaining gray cast iron with a uniform distribution of finely divided graphite was patented, 1,705,972, and assigned to Edelgussverband, G. M. B. H., Berlin-Dahlem, Germany. It consists in destroying the graphite nuclei by heating and holding the metal at 1,250 to 1,300 deg. C. for a few hours before casting. Another patent, 1,705,995, on a fine cast iron assigned to the same company also covers the superheating and holding the molten iron for a period at a high heat.

A self-lubricating bearing metal, in which the lubricating material is deposited electrolytically, was patented, 1,702,927, and assigned to the Cleveland Graphite Bronze Co. The same company was also assigned a patent 1,704,208, on an alloy containing 82 per cent of lead, 9 of tin, 4 of antimony, 3 of zinc, 1.5 of copper, and 0.5 per cent of aluminum.

Trade Publications

AUTOMOTIVE EQUIPMENT. The Consolidated Machine Tool Corporation, Rochester, N. Y., has published an attractive pamphlet entitled "Equipment for Automotive and Other High Production Shops." It consists of large, clear photographs of various types of machines in operation and the work done upon them, together with diagrams of the set ups. Several types of small tools are listed at the rear. The catalog contains 72, 11x8½-in. pages.

BORING BARS AND REAMERS. The Gisholt Machine Co., Madison, Wis., has published a pamphlet showing boring bars and reamers for turret lathes, engine lathes, and boring mills, and other types of machines. The features of construction are taken up and the specifications are listed.

FLEXIBLE COUPLINGS. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., has published bulletin No. 329 on an all-metal flexible coupling. A full description is given, together with a table of sizes and dimensions.

GENERAL ELECTRIC PUBLICATIONS. The General Electric Co., Schenectady, N. Y., has published Bulletin No. 98-A, superseding 98, on adjustable-varying-speed motors, type BSR, for 60-cycle, single-phase operation. Pamphlet No. 1,102 deals with electric heating equipment for hot galvanizing tanks. Both bulletins are printed on 11x8½-in. loose-leaf sheets.

GRINDING WHEELS. The Abrasive Co., Div. of Simonds Saw & Steel Co., Tacony & Fraley Sts., Philadelphia, Pa., has published Catalog ESA-34 on various grinding wheels and other abrasive products. Photographs are given and the catalog is replete with tables of sizes and specifications.

POWER PRESSES. The V & O Press Co., Union Turnpike, Hudson, N. Y., has published catalog No. 29 on power presses of the inclinable, straight-sided, bench, horning and wiring, foot, double-action, arch, and double-crank types. Other products described are: King pressure toggles, automatic roll feeds, and automatic dial feeds, together with automatic threading and trimming machines. The catalog contains 56, 10½x 7½-in. pages.

SHELL END MILLS. The National Twist Drill & Tool Co., Detroit, Mich., has published a folder showing the method of operation and tables of sizes for "Parabolic" shell and mills with deep counterbores. These end mills range from 1¼ to 6 in. in diam., and from 1 to 2¼ in. in width.

SNAGGING EQUIPMENT, HIGH SPEED. The Norton Co., Worcester, Mass., has published a pamphlet entitled "Complete Equipment for High Speed Snagging," which shows Bakelite and "Unicast" wheels for operation at 9,000 s.f.p.m., and several floorstand and swing-frame grinding machines suitable for using such wheels. The catalog contains fifteen 7x5-in. pages.

LABOR CONDITIONS IN MACHINE SHOPS. The U. S. Department of Labor, Bureau of Labor Statistics, has published bulletin No. 471, entitled "Wages and Hours of Labor in Foundries and Machine Shops for 1927." The tables give the average number of days worked, average and classified earnings per hour, and average and classified full-time hours per week, together with much other data. From the bulletin, a good idea of the conditions obtaining in various sections of the country may be obtained.

TRADE ASSOCIATION CONVENTIONS. The U. S. Chamber of Commerce, Washington, D. C., has published a bulletin containing the convention dates of the branches of the National Trade Association. These are ranged alphabetically and by months. The bulletin is issued by the Trade Association Department.

News of the Week

S.A.E. Holds Aeronautic Meeting in Detroit

Using the Aircraft Show as a magnet to draw those interested in aviation to Detroit, the Society of Automotive engineers had a two-day meeting at the Book-Cadillac on April 9 and 10. The first day was devoted to a trip to the Ford Airport and Airplane Factory, a visit to the show and an aeronautic dinner with Hon. E. P. Warner as toastmaster. The program included the presentation of Wright Brothers' medal for the best paper on aerodynamics, research and design to Lt.-Commander C. H. Havill, U.S.N., for his research in aircraft propellers. Brig.-Gen. W. E. Gillmore, Chief of the Air Corps, U. S. Army, told of the research and development work at Wright Field, in Dayton, Ohio. His address included facts as to photography from high altitudes; building, flying and crashing planes; and other studies to help commercial as well as military aviation.

A general standardization conference was held on the second day, together with technical sessions that included a paper on the Magneto Compass, by F. P. Wills; Aircraft Development, by V. E. Clark; Gliding Experiences, by Amelia Earhart and Reed Landis; and Gliding and Soaring Flight, by D. Wolfgang Klemperer.

At the evening session Dr. G. W. Lewis, Director of the N.A.C.A., told of the development of the new cowling for radial engines by which the drag is reduced and the speed of the plane appreciably increased when the cowling is properly applied. Wing Slots were discussed by Lt. C. B. Harper of the Bureau of Aeronautics and proved to be a very interesting subject.

Second Aircraft Show

With more planes and accessories crowding Convention Hall than last year, the second Annual All-American Aircraft Show was held in Detroit, April 6 to 14 inclusive. While many planes showed little change during the year and few startling departures from current practice were noticed, there were a few ships that attracted particular attention, and many minor improvements were seen on a large number of the planes shown. More attention is being paid to details, both of construction and of the minor things that make for the convenience and comfort of the pilot or passenger. There seems to be a tendency toward a smaller lower wing in biplanes using it partly for the purpose of securing better bracing for the large upper wing. A few monoplanes follow this plan to a slight degree by having a very short, or stub, wing that acts as a brace connection and hardly figures at all as lifting surface.

The engine exhibits were attractively arranged and complete in detail as regards the various types manufactured by the individual companies. All the leading commercial manufacturers were to be found, including Pratt & Whitney, Wright, Curtiss, Packard, Continental and Kinner. Air-cooled types predominated, generally of the radial type, but with an occasional straight-in-line to be seen. An unusual type, exhibited for the first time, was a two-cycle, radial, air-cooled engine of six cylinders, two threes, staggered. No Diesel types were shown.

Two planes were exhibited with a new fuselage construction, just introduced from England, in which Duralumin ribs are placed on steel spars, the covering being cloth. Because of its easy replacement, cloth is still maintaining its own against metal fuselage covering.

In all 106 planes were shown, and a large amount of space was devoted to accessories. In fact so much equipment was shown as to give the hall the appearance of being overcrowded. A large attendance was recorded daily, and aside from the sightseers, the industry was well represented.

Kraut Now Heads Giddings & Lewis

The Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., manufacturing horizontal boring, drilling and milling machines exclusively, has completed a program of reorganization and refinancing, with a public offering of stock, following the retirement of F. J. Rueping, as president, and the purchase of his controlling interest and that of the Rueping Estate, Incorporated, by a group of local and Eastern capital. H. B. Kraut, since 1924 vice-president and general manager, has been elected president and chairman of the board. W. J. Radcliffe, president of the E. A. Kinsey Co., Cincinnati, is first vice-president. A. T. Brenner, G. P. Heathcote and F. W. Chadbourne, of the old organization, are second vice-president, treasurer and secretary, respectively. Directors include L. H. Swindt, president of the Swindt Machinery Co., Philadelphia, and T. W. Meikeljohn, C. H. Thornton, F. H. Boyle and T. E. Ahern, all of Fond du Lac. K. F. Gallimore continues as chief engineer; W. E. Rutz, works superintendent, and Carl Gebuhr, in charge of sales.

H. B. Kraut
President, Giddings & Lewis Machine Tool Co.

The Giddings & Lewis company was established in 1859 and until 1905 was a manufacturer of sawmill equipment. Metalworking equipment lines were introduced in 1905, and developed so that in 1910 the woodworking line was abandoned. Production of horizontal boring machines was undertaken on a large scale in 1914, and for the past two years has been the chief line.

Progress Symposium at Metal Trade Meeting

A symposium on the problems and progress in various branches of industry will feature the thirty-first annual convention of the National Metal Trades Association, which will be held at the Drake Hotel, Chicago, April 24 and 25, according to the program announced by Harold C. Smith, president of the Illinois Tool Works Co., and of the National Metal Trades Association. "Problems and Progress in Transportation" will be discussed by Elisha Lee of the Pennsylvania R.R., and G. W. Vaughn, of the Wright Aeronautical Corporation, will cover air transportation. Dr. Harry Meyers, of the Frigidaire Corporation, will talk on "Problems and Progress in Employee Relations," followed by Sterling Morton, of the Teletype Corporation, on the same subject, as well as Walter Gordon Merritt, counsel for the League for Industrial Rights. "Progress in Agriculture" will also be discussed.

Dr. Thomas Nixon Carver, of Harvard University, will ask the pertinent question "How Long Will Prosperity Last?" Another speaker will be Whiting Williams, Counsellor in Industrial Relations, who will talk on "Men and Managers under Mussolini, Marx and Hoover." The part the Association takes in employee training and education will be described by Louis Ruthenburg in his report of the Committee on Industrial Education. As a part of this report George Seyler, of the Lunkenheimer Co., will demonstrate the modified conference method of foreman training.

Unemployment is the Chief Concern of British Industry

By Our London Correspondent

WHILE the rapidly approaching general election contest is occupying the minds of most people here, although not to the exclusion of business, the main problem all parties are laying themselves out either to solve or to ameliorate is unemployment. A number of proposals are being placed before the electors, but except perhaps in the suggestion of further development of electric supply schemes, they do not greatly concern the mechanical or electrical engineer. We are being reminded again that, in addition to the somewhat fluctuating increase in the numbers of the unemployed, there is a large increase in the numbers of persons actually employed. It has been estimated, in fact, that within the last four or five years some 550,000 people have entered industry, or at least have entered the national insurance scheme and have thus become qualified for unemployment benefit (the so-called dole), if they fall out of work. Then too, as compared with pre-war conditions, emigration has declined, so that some 300,000 or 400,000 who would have left the country are still with us and are helping to raise the unemployment figures.

Skilled Men Going Abroad

On the other hand, for several years complaints have been heard in the engineering industry, and particularly in the machine tool section, that large numbers of skilled workpeople have gone abroad. Although engineering workpeople of a kind cannot be described as scarce, still in some areas specially skilled men are difficult to procure when wanted. Indeed the recent increase in the quota of British emigrants to the United States has elicited the suggestion that still more of the best workmen of Great Britain may emigrate, possibly to the detriment of British industry; for it is recognized that only men of somewhat special industrial capacity and good physical condition are likely to be accepted for entry into the United States, thus raising the proportion of inferior workers at home.

Again, the high unemployment figures are swelled by the decline in export trade, which, according to a statement in Parliament, has "caused the unemployment of from 700,000 to 800,000 in this country, as calculated by the best-informed economists." To a very large extent, export trading is severely handicapped by prevailing conditions, tariffs, rates of exchange, conditions of employment and what not, trades concerned with the home markets being recognized as in a protected condition. Efforts to increase overseas trading are continuous and, at the moment, are being focused to promote trade with Russia on a private basis. The latest manifestation of this is the visit to Russia being made by some 85 delegates representing about 150 firms, including a well-known machine tool firm, the whole with a capital of about 250 million pounds.

The machine tool industry still pursues the more or less even tenor of its way and if there is any change it is probably in the direction of improvement. One of the oldest firms has disappeared, the possibility of this having been suggested in these columns of the issue of March 7. Nearly the whole of the plant and equipment is being sold off piecemeal by a dealer.

Out of its last exhibition held in London back in September the Machine Tool Trades Association made a net profit of £7,787. In view of the need for increased foreign trade, and consequently the advantage of a knowledge of foreign languages, it is proposed, for proficiency in that direction, to use part of the surplus by awarding the sum of £250 per annum for three years to employees of the firms in the association. A proposal to grant a rebate on the space rent to members participating in the exhibition was vetoed, apparently by legal opinion.

Matters do not appear to be quite definitely settled, but apparently the next exhibition will be held in the autumn of 1932, probably in Olympia, London, W.

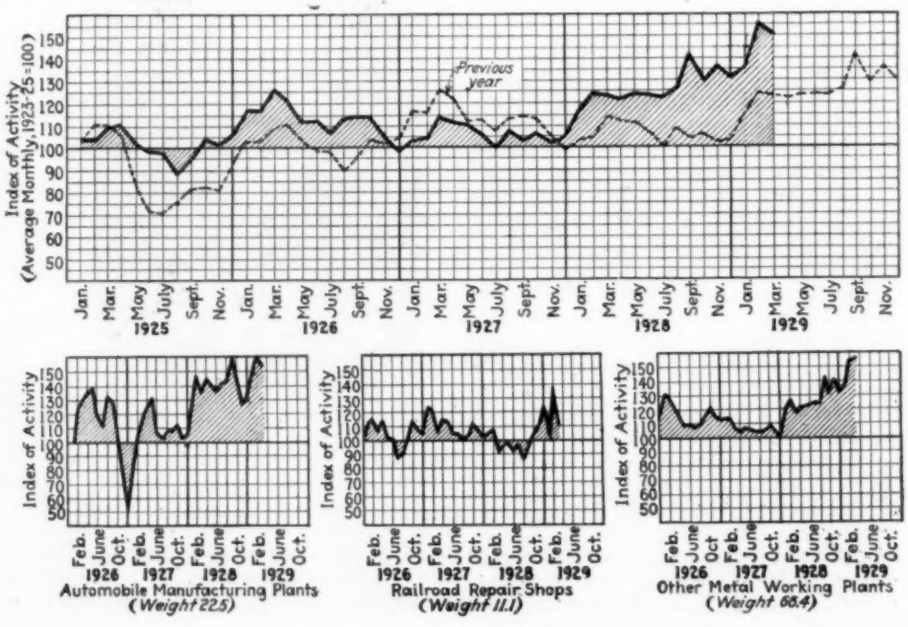
A considerable number of British machine tool men, and also British machine tool users, visited the exhibition of machine tools that formed part of the technical fair at Leipzig recently. This year, chiefly owing to the firms that make the most extended effort to sell abroad, British machine tools were well in evidence in a hall of which a portion was allotted to imported tools separated from the German display.

High Productive Activity Continues

DURING the first quarter of 1929 the greatest activity in the history of the metal-working industry was recorded, based on the consumption of electricity in plants of this industry. The average rate of operations of the metal-working industry during the quarter is about 17.6 per cent higher than for the same period last year, and about 32.6 per cent over the figure for the first quarter of 1927. The peak of operations during the current first quarter seems to have been reached in February, when a record rate of activity was recorded.

Notwithstanding the fact that the number of new automobiles turned out during March was by far the largest in the history of the industry, yet, reports on the amount of electrical energy consumed by these plants during the month indicated the average rate of operations of these plants, including the manufacture of replacement parts and accessories, was some 5 per cent under the February rate of operations, but was still about 13 per cent over the rate of operations recorded during March last year. The operations of the automobile plants are following the general trend of last year very closely, only on a higher plane.

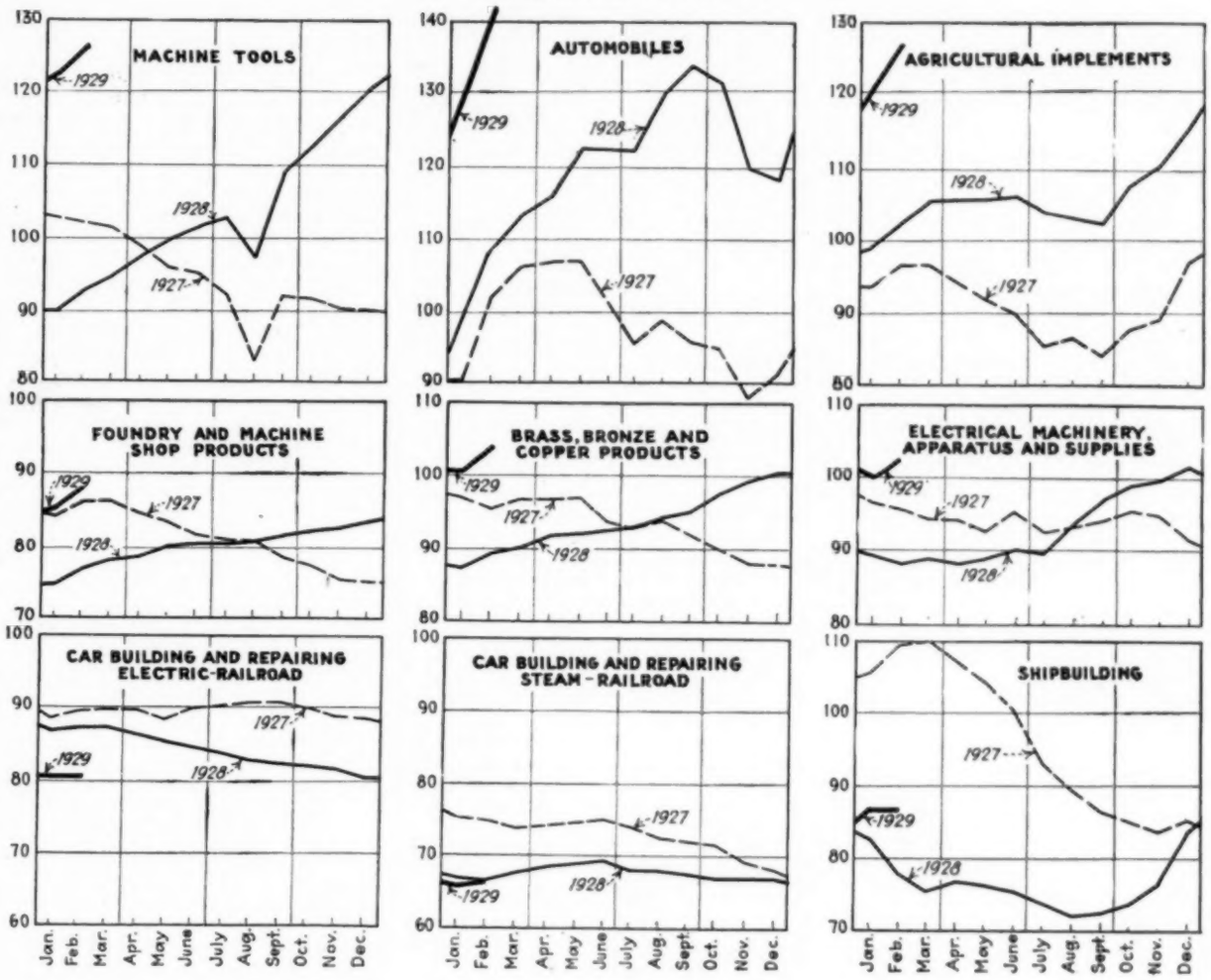
In other metal-working plants, outside of railroad repair shops, there was a slight increase during March in the already extremely high rate of activity. The March rate of operations in these plants was the highest on record, being 1.3 per cent above February, the previous record month, and 32.8 per cent



Trend of Employment in the Metal-Working Industries

Data Supplied by the Bureau of Labor Statistics

Monthly Average for 1923—100



FIGURES now available for the month of February indicate a continued upward trend in the number of employed in metal-working shops. The most noticeable increase took place in the automotive industry, where a rise of 9 per cent over the previous month took place and of 32 per cent over the figure for February, 1928. Other large gains over January figures are noted in the machine tool industry, 3½ per cent, and in agricultural implement manufacturing plants, 4 per cent. Shipbuilding yards have apparently reached a saturation point for the present, and car building and repairing shops, both electric and steam railroad, are also holding an even level.

above March last year. The average rate of operations in these plants during the first quarter of the current year was 22.8 per cent over that for the same period last year.

Analysis Made of Material Purchases

Purchases of raw materials, semi-finished products for further manufacture, mill supplies, maintenance, material and equipment by manufacturers of iron and steel products, not including machinery, operating establishments in Cleveland and environs with an annual ouput of $100,000 or more were valued at $158,907,292 during 1927 while sales of the finished products of these same concerns during the year amounted to $275,918,513, according to a preliminary report on a census of industrial purchases and sales conducted by the Department of Commerce with the assistance of the Cleveland Chamber of Commerce.

Purchases in the raw material group included iron ore valued at $11,884,628. The cost of semi-finished products were divided among steel valued at $59,395,025; pig iron, $20,512,397; scrap iron, $12,384,556; nonferrous metals, $4,393,696; wire, $3,525,529; castings, $3,230,941; plumbing supplies, $1,429,060; tin, $1,404,398; iron alloys, $1,289,168; while electrical supplies; bolts, nuts, screws and rivets; paints, enamels, lacquers; textiles; lumber; and other miscellaneous semi-finished products were purchased in lesser amounts.

Total purchases of mill supplies, fuel, packing materials, etc., amounting to $21,999,606 included fuel and power valued at $13,212,843; packing and shipping supplies, $1,626,446; tools $621,904; oils and greases, $519,417; and tool steel $268,982. The cost for equipment and maintenance for the year is recorded as $10,931,452. Of this total $4,006,839 is charged to repairs and additions to buildings and repairs to equipment; $2,289,340 for factory equipment; and $925,044 for new machinery.

The present census is devoted to ascertaining the practicability and scope of questions concerning the purchase by manufacturers that could be included in a general census of distribution now pending. The basic data developed in these censuses will provide, it is hoped, a more intelligent basis for marketing and distribution policies.

BUSINESS BAROMETER . . . . *If the managers of business avert threatened over production in time, the evil effects of dear money ought to be limited*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

UPON the basis of the latest census returns it is estimated that there are about 45,000,000 men, women and children in the United States who are gainfully employed. By those who have investigated the matter it is also frequently asserted that some 15,000,000 or 20,000,000 persons are now interested in the security market as speculators or investors. If these figures are accurate, and they are generally accepted, it is clear that the speculators must include virtually all of the well-to-do among the employed, and it is not surprising that the business men of the country are pre-occupied with the news from the stock exchanges and the money market.

Last week money was a shade easier, and the stock market was somewhat quieter, but the probability of bearish accidents at high altitudes was emphasized by the decline in the stocks of traction companies that serve New York City, when the Supreme Court handed down a decision which was construed as adverse to a 7-cent fare. The value of Interborough stock, for instance, was nearly cut in half, and the other traction companies followed suit. Of course, the decision would have caused a decline at any time, but experienced judges of the market say that the drop would have been less severe if it had occurred four or five weeks ago when bullish enthusiasm was at its height.

The truth is that the mathematics and psychology of the speculator are so interwoven that his reaction to current developments is unpredictable, and allowances must always be made for what might be called the twilight zone of emotion, by which all speculative operators are surrounded. The atmosphere of this zone has become somewhat murky of late, and a revival of the optimistic spirit seems unlikely until there has been a substantial reduction in the volume of brokers' loans, and call money is somewhat easier.

Last Thursday's statement of the Federal Reserve Banks showed that they are making progress in their efforts to keep fresh credit out of the securities markets, for brokers' loans were reduced by another $135,000,000. Since the warning issued on February 7, loans made to brokers by banks have declined half a billion dollars, but those made by "others" have increased $260,000,000; and probably the authorities consider that they still have a long way to go before they will be justified in taking steps to ease the present tightness of credit.

The gold movement of course has a great bearing on the situation and last week's net receipts of $31,522,000, including that released from earmark for export, were sensational. But it is still too early to conclude that the total movement will be either large enough, or so ineffectively disposed by the banks, as to re-enthuse speculation.

Quieter stock markets and a more conservative interpretation of the news are, therefore, to be expected for the present, and the question that most business men are now asking is will the quietude of speculation help or harm what is called general business, to differentiate it from the purchase and sale of stocks and bonds.

In answering this question a reasoned and reasonable optimism seems warranted, but there are some spots in the commercial situation that may become foci of irritation unless corrective measures are speedily applied.

In the steel industry and the automobile industry there are also some signs of over production as a result of the capacity operations that have been the rule for the last three or four months. The automobile makers are already buying slightly less steel, and, although the mills entered April with larger unfilled orders than they had a month earlier, some of the producers say that a recession is likely to begin within a month or so. Observers of the industry say it has already passed its production peak, having accumulated as large stocks as seems wise against the spring demand.

Building is still a laggard. Contracts awarded in March were 18 per cent less than a year ago according to the F. W. Dodge Corporation, and the first quarter fell 15 per cent behind. But there are signs of better times ahead for this industry. One is that the total of new security issues for the first quarter broke all records by a wide margin, and whether the money is raised by stocks or bonds the proceeds eventually find their way mostly into construction. Another is that contemplated work reported and permits issued during March were slightly larger than a year ago for the first time in several months. Car loadings continue to run larger.

If there are excessive accumulations of goods anywhere, the fact ought to be more obvious to manufacturers than to anyone else, for they must exist in their own or their dealers' hands. As there has been little speculative distention in the commodity markets, where futures are dealt in, there are no accumulated stocks or holdings to liquidate.

In the general news there is little that is disturbing except to those who consider that a session of Congress is always an occasion for caution, and, if the managers of business avert in time the over production that is threatened, we may reasonably hope that the evil effects of dear money will be limited.

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From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

A SLIGHTLY lower level of activity was noted in the machine tool trade in Detroit and in the New England territory last week, but in general the high volume of sales recorded in the first quarter is being maintained this month, and the prospects for future business remains exceptionally bright. Even the most pessimistic look for no general recession until well into the summer. Detroit activity is by no means low, however: the automobile plants there and elsewhere are all working at capacity and employment is the highest in the history of the city. Even the small shops are doing a record business, particularly tool and die builders. Due to the acute delivery situation, the slight breathing spell noted by New England tool builders is rather welcome at this time.

WITH spring almost a month ahead of normal this year, sales of contractors' and road building equipment have jumped to high levels in many centers. In the South equipment purchases by the textile mills is the outstanding feature of the machinery market in that district. Railroads continue to lag in buying equipment in all centers. In Chicago, where large lists were issued earlier in the year, orders are coming in very slowly from this source.

BECAUSE of the long delivery schedules of the machine tool builders, dealers in used and rebuilt production machinery are finding ready markets, when they can lay their hands on good equipment, which is scarce, and with prices on the up-swing are making a better margin of profit than in some time.

CANADA continues to enjoy record-breaking activity, due largely to expansion programs of two of the leading railroads.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CANADA

One of the most convincing indications of the great industrial activity in Canada at present is the production report on iron and steel for the first quarter of the year, which shows the output of the former product to be 45 per cent and of the latter 19 per cent larger than in the corresponding period of last year. This unprecedented expansion is partly attributable to the extension and replacement plans of the two major railway companies, but it reflects also the large orders placed by these organizations for rolling stock and other equipment, the requirements of manufacturers of farm implements, automobiles and industrial machinery (particularly that needed for mining), and the increased quantity of steel for general construction purposes. The new equipment proposals of the Canadian Pacific Railway are quite extensive. They include 20 oil burning locomotives, 119 passenger cars, 8,811 freight cars and much service equipment.

The Steel Co. of Canada is showing excellent returns, while the McKinnon Steel Corporation in Quebec reports record shipments, due to the general activity in industrial enterprises. The Dominion Engineering Works, Montreal, are very busy turning out machines for several new paper mills.

Prospects for the year's operations of the Nova Scotia Steel and Coal Co., Ltd., are more hopeful than last year, as extensive contracts have been secured for the car shops which will not only keep them fully occupied for some months but will improve conditions at the company's main works. The Merchant Mill of the Algoma Steel Corporation at Sault Ste. Marie, is running night and day and the unfilled orders on hand will insure the working of this end of the plant for more than a year. The Hamilton Bridge Co. has just been awarded the contract for the steel work for the new Bank of Commerce building in Toronto. It is expected that the order will run to nearly a million dollars.

Remarkable gains in the volume of Canadian construction were recorded during the first quarter of the current year. Contracts awarded totaled $97,514,000, being an increase of 40.7 per cent when compared with the same period in 1928.

INDIANAPOLIS

Business in machinery and machine tools here continues to hold a high level. The sales volume is better than it was this time last year and indications point to more business. There are some dull spots in the demand, but they are comparatively few, and the active spots are really active.

Demand from automobile sources, and this means all of them, is good. The factories in this state are producing more machines than they have for years and some of them are breaking records. The output at the Marmon plant, where production has reached 250 cars a day, is limited only by facilities and these are being increased as rapidly as possible so that other assembly lines may be started. Studebaker, Chrysler and Auburn are reporting almost capacity production and the Stutz plant also is busy. Much special equipment is being sold to truck and automobile body plants in this state. The automobile accessory factories also are rather ready buyers.

With the coming of spring the demand for small machine shop equipment for garages is picking up rapidly. Grinders, small lathes, drill presses and like equipment are having a ready sale.

Railroads are confining their buying to absolute requirements and seem to be just about holding their own in the machine tool market with this season last year.

Demand for special brick-making machinery is improving rapidly as also is the demand for contractors' equipment. The demand from coal fields is slumping, due to the lack of demand in the market for coal and little is expected of this market until the fall season opens. A good demand for tools continues to come from airplane interests.

CINCINNATI

With very few exceptions, the machine tool manufacturers of the Cincinnati district report that in the past week there was no perceptible change in market conditions, sales remaining at the same good level as in the previous week. The majority express the opinion that the demand will remain as it is for an indefinite period, but there are some who forecast a slight lull, due to seasonal reasons, in the near future.

Local selling agents report that sales in adjacent territory were at a good level during the week. As this branch of the trade views the situation, there will be no change of consequence in market conditions for quite a while, and the present satisfactory demand will continue.

The feature of the week's business was the sale of single tools, but here and there was an order for two or three pieces of equipment. The orders were well diversified as to sizes and types of tools. A few scattering orders from railroads and concerns in the automotive industry called for single tools, and here and there was a small order for export.

The great majority of the manufacturers and also most of the selling agents report that the week's inquiries were both numerous and of excellent tone. Inquiries from railroads and concerns in the automobile field were scattering and small in number, none of the requirements being large.

SOUTHERN DISTRICT

Slow but steady improvement has been noted in the machinery and machine tool business in the Southern District during the past two weeks, and with one or two exceptions distributors report sales better than they were at this time last year, and the outlook unusually good for the late spring and summer period.

More activity is being shown in demand for contractors' equipment than at any time this season, and from present tone of inquiries it seems certain this trade will be excellent the next few weeks. Road building equipment is also considerably more active than it has been, and, as there are few southeastern states not planning larger road building and maintenance programs than last season, this trade also is very promising for the next few weeks, and is expected to exceed last year. Woodworking machinery, however, is not very active at this time, though a few good sales have been recently made to furniture factories in Georgia, East Tennessee and the Carolinas, with prospects good for improvement.

Textile mill demand continues to feature the market in this district, and with several million dollars worth of new construction now in progress or planned for the near future, there seems little doubt but that textile mills will continue active in the machinery market until late summer, and that 1929 will prove one of the largest years in the history of the business as regards machinery. Railroads are doing some buying of heavier equipment but are not as active in the market yet as had been expected. Smaller machine shops and garages continue inactive.

CHICAGO

Business in machine tools thus far in April shows no indication of recession. Manufacturers' representatives and distributors of practically all lines of production machinery report trade as keeping pace with that of the first quarter of the year. Dealers in used equipment state that demand for metal-working machinery in first-class condition is better than during any time for several months past, and that the prices realized permit of a good margin of profit. There has been talk of an advance in prices on some standard lines of shop equipment, but with the exception of one brand of shapers, which has shown a rather sharp advance, thus far there has been no definite announcement by manufacturers' agents that the lines they represent will be listed at an increased price.

Recent demand for tools varies little in character from that prevailing for the last several weeks. General industry is buying freely throughout the Middle West. Railroads are slowly closing on some units itemized in lists issued earlier in the year. Some increased activity is noted in the demand for woodworking machinery due to the Chicago Board of Education having entered the market with inquiries for a number of tools needed for junior high schools.

DETROIT

A slight let-up has been noted in some quarters of the machinery and machine tool field here, but business is still very good, and there are prospects that it will continue to improve during the next few months.

All of the automobile manufacturers are working at capacity and the prediction is made that 1929 will far surpass in production any year in the history of the industry. It is believed that 5,000,000 cars will be built during the year and if this is done it will mean of course that most of them will be produced in this area and that the machine tool trade will benefit accordingly. Most of the business during the past few weeks has been in replacement equipment and it seems likely that this will be the case for the next few weeks. No unusual programs of expansion are in the immediate offing.

Hudson-Essex, Ford, Chevrolet and Graham-Paige cars are being produced at unprecedented rates and the demand for equipment in all of these concerns has remained at a high point for some time.

Chrysler has been a steady and consistent purchaser of a wide variety of equipment and is still in the market for a great deal of replacement machinery. AC Spark Plug at Flint has broken all production records and has been in the market for some machinery and equipment. Buick expects to get into production with its new Marquette, a light, low-priced car with an L-head motor.

Most of the accessory and parts builders are working at capacity and the small tool

and die shops are busier than they have ever been before.

Not only in Detroit but in Lansing, Flint and Pontiac the level of employment and the general level of prosperity are higher than they have been in many years.

NEW ENGLAND

Orders for a variety of machine tools are being booked by New England builders, but at a slightly lower level of activity. The fluctuation from last week's volume of business was small, and not general in scope. Industrial conditions continue more or less congested, and the prevailing hustle and bustle should extend through the summer months without aid of additional new business. Plants without exception are on full time, and overtime schedules are only limited by the shortage of man power.

Agricultural and road building equipment is approaching peak demand through this territory, and there is a good distribution of woodworking equipment. A Fitchburg company is shortly to equip a plant with woodworking machinery and motors. A Wrentham (Mass.) concern is buying for a machine shop, in the course of construction.

While the machine tool industry is taking a short breathing spell other general lines of machinery have been more active. A print-butter plant is being equipped at Springfield, Mass., with conveying, handling, cutting, wrapping and packing machinery at a cost of $100,000. The Package Machinery Co. is installing combination cutting-wrapping-packing machines producing 1-lb. butter prints, the first of the type to be used in this country.

NEW YORK

Little change has taken place in the New York market for machine tools in some time. From all indications as much business will be placed in the second quarter as in the first, which was one of the periods of highest activity in the history of local dealers and factory representatives. There is certainly at present no indications of a let-up in buying in the near future.

With delivery dates on new machines being placed from two to six months hence, dealers handling used and rebuilt machinery are taking full advantage of the situation and are doing a record business. Good second-hand equipment is scarce, however, and prices are being bid up accordingly. One such firm reported shipments during the first quarter double the volume for the same period last year.

An interesting development taking effect on April 1 was the raising of prices of certain lines of electric motors about 12½ per cent, as if to join the trend of machine tool prices which have been going upward for the past two years. At least two of the tool builders put price changes into effect at the same time, but not as a result of the increase in motor prices. Another noteworthy event was the inquiry for some tools on the part of the Delaware, Lackawanna & Western R.R. for the first time in almost a year, and one of the few roads, besides the New York Central, that has shown any interest in shop equipment this year.

Sales reported by the Triplex Machine Tool Co. included: a large "Grand Rapids" surface grinder, an Ames bench miller, two bench drill presses, a Van Norman milling machine, two filing machines, a wet tool grinder and a spring coiler.

Government to Form Purchase Board

As a part of its general program to improve the Government's purchasing methods, the Federal Purchasing Board is planning to make a study of the production end of the machinery industry in order that the various departments may be given a better knowledge of the availability of the material that they need. For the purpose of making this study, a committee on machinery has been created on which W. H. Rastall, Chief of the Mechanical Section of the Commerce Department, and two other Government officials will serve. Meetings are to be held at monthly intervals.

The committee on machinery during each of its monthly meetings will analyze the purchasing practices of the various departments. As a result of the committee's program for co-ordinating facts on production with the requirements of the departments, a more economic purchasing policy is expected to follow. J. A. Egleston, secretary of the Federal Purchasing Board, believes that the most important feature of the board's work, will be to induce government purchasing officials to think in terms of value rather than of spending a certain definite sum for an article.

Aluminum Industries Buys Diamond Plant

Following the recent announcement of the new Permite Unitype piston, Aluminum Industries, Inc., large manufacturers of aluminum alloy replacement pistons, announces the purchase of the Diamond Motor Parts Co., of St. Cloud, Minn. The Diamond company is one of the largest producers of replacement parts in the automotive industry, with a 15-acre plant and 130,000 sq.ft. of floor space under roof. This plant has been operating under a receivership for several months, and the sale was only recently confirmed by the court. While announcement of the terms of the sale was withheld, the appraisal value of the plant, equipment, and inventory was fixed at $1,250,000. The property of the Diamond company, which was organized in 1923, represents an investment of $3,000,000. The plant has a capacity of 150,000 parts daily.

The St. Cloud plant will be operated solely as a manufacturing and shipping division, and the product will be marketed under the name of the Permite-Diamond line. While the name of the Diamond company eventually will be dropped, the trade mark will be maintained and the consolidated company will be known as Aluminum Industries, Incorporated.

Business Items

Bendix Aviation corporation has been formed to acquire the assets and business of the Bendix Corporation and subsidiaries, including the Bendix Brake Co., the Eclipse Machine Co. and its subsidiaries, the Delco Aviation Corporation, the assets and business of Stromberg Carburetor Co. of America, including its subsidiaries, the Scintilla Magneto Corporation, and other companies in the general aviation accessory field. The Electric Auto-Lite Co., formerly owner of a minority interest in Eclipse Machine Co., will contribute valuable patent rights to the new corporation. The new corporation through its subsidiaries will continue its activities in the automotive industry. Vincent Bendix will be president.

The Republic Motor Truck Co., Inc., and the Commercial Truck Division of the American-La France and Foamite Corporation have agreed to consolidate, subject to the ratification of the Republic stockholders. A new corporation, to be called the La France-Republic Corporation, will be formed to take over the assets and liabilities of the Republic Motor Truck Co., Inc., together with its wholly owned subsidiary, the Linn Manufacturing Co., of Morris, N. Y., and also the truck assets of the American-La France and Foamite Corporation. Charles B. Rose, president of the American-La France firm will be president of the new concern.

The merger of the Fairchild Aviation, Ltd., of Grand Mere, Que.; International Airways of Canada, Ltd., with headquarters in Hamilton, Ont., and the Canadian Airways, Ltd., of Toronto and Hamilton, has been officially announced. Each company will retain its own identity as an operating unit. The move is calculated to give an impetus to commercial aviation in Canada, and will undoubtedly strengthen the relative position of the three companies. The Fairchild company will shortly construct a large aircraft factory in Canada for the manufacture of Fairchild machines.

A number of changes have been made in the management of the Pierce-Butler and Pierce Manufacturing Corporation, Syracuse, N. Y., manufacturers of boilers, engines, and heating equipment. Stanley B. DeLong, during the past year general manager of operations in Syracuse, has been elected president, while Irving N. Beeler, of Syracuse, continues as chairman of the board. Last year was a period of readjustment in the physical properties of the company, but the firm is now said to be definitely on the upgrade.

The Studebaker Corporation, of South Bend, Ind., showed an increase of approximately $2,000,000 in net income over the previous year in its annual statement submitted recently. Net income amounted to $13,947,181, representing an increase of 16.8 per cent over the net income for 1927. Much of the increased earnings was attributed to a 41 per cent expansion in export shipment. The total volume of sales increased 17.7 per cent.

The Decatur (Ill.) Brass and Aluminum Foundry Co. has removed to the plant of the former Halladay Co., Decatur, where it will install a new half-ton electric furnace and other equipment incident to its entry in the iron and semi-steel castings fields, Fred Smith, president, announced. The company is embarking upon an expansion program and will enter new fields in the manufacture of bronze, brass and aluminum patterns, plates and castings.

General Motors of Canada, Ltd., will handle all export business in Chevrolet cars for New Zealand, Egypt and Spain from the plant at Oshawa, Ontario, according to announcement by company officials following arrangements for this allotment to the Canadian factory concluded with the General Motors Corporation in New York. The additional work at Oshawa will mean that the Chevrolet line at that plant will be kept running practically the year round.

The Allis Chalmers Manufacturing Co., is now building additional factory units for tractor production and a heat-treating plant at Milwaukee. Indications are that the company will be making 50 small tractors a day by July 1 and production of 100 or more a day is expected by the fall. Production is also being increased at the company's Monarch tractor plant at Springfield, Illinois.

The Gisholt Machine Co., of Madison, Wis., is now represented in the western New York territory by Arnold S. Beckman, 850 Potomac Ave., Buffalo, instead of by the firm of Homer Strong, Inc., of Buffalo and Rochester, in accordance with its policy of direct representation. Mr. Beckman has been with the Gisholt company for the past fifteen years.

The Acorn Bearing Co., New Britain, Conn., ball bearing manufacturers, is shortly to move into new quarters at South Main and Stanley Streets. Work has been started on a new 1-story plant 45 x 85 feet. Increased business has made the Mill Street plant inadequate. In its new site the company has purchased a plot 100 x 150 feet, which allows for still further expansion.

The Moore Shipbuilding plant of the Bethlehem Shipbuilding Corporation at Elizabethport, N. J., will be abandoned, according to Lafayette Fisher, general manager. In war times there were 4,000 workmen employed in the Moore yards, which of late years had dwindled to around 400. Recently the activities of the works were confined to manufacturing marine pumps and winches.

Petty & Wherry, dealers in transmission equipment, with offices and warehouses in New York City and Brooklyn, have just purchased the business, stock and good will of The Coleman Power Transmission Co. of Brooklyn. The firm represents the Dodge Manufacturing Co., the Chain Belt Co., and others.

The Eclipse Co. is adding a $175,000 extension, covering a ground space of 300x100 ft., to its Walkersville (Ont.) plant. A two-story office building is also being built. The new factory building will be used for the manufacture of Bendix drives and assembling of Bendix brakes.

The Holmes Foundry plant in Sarnia, Ont., is operating after being closed down since March, 1927. A new financial arrangement has been made, and the company will proceed with a contract for the manufacture of cylinder blocks at the rate of 300 a day for the Ford Co. of Canada. L. G. and W. W. Blunt, of Port Huron, Ont., will have direction of the company.

The Weaver Brothers Co., of Clinton, Mich., has moved to Adrian, Mich., where increased shipping facilities are available and where more space will be provided to increase production. The company makes equipment for the pickling room.

The offices of the American Engineering Co., Stoker Division, have been moved from 100 Broadway to 40 West 40th St., New York, N. Y. The company makes the Taylor stoker, Lo-Hed hoists, Juruick refrigerating machines and marine equipment.

The firm of Johnson & Wierk, Grand Central Terminal Bldg., New York, has been formed to handle a general consulting practice, including reports, design, and construction supervision of engineering projects, including machine design.

The American Can Co., formerly located at 120 Broadway, New York, has changed its address to 230 Park Ave. The Equipment Division of the company is now marketing the line of "Canco" presses.

The Whitney Manufacturing Co., Hartford, Conn., has moved its Boston office to the Boston Consolidated Bldg., 250 Stuart St. G. C. Steil is in charge as district manager.

Personals

J. A. McLennan, Chicago, who joined the Siegel Battery Manufacturing Co., Waterloo, Iowa, as supervising engineer and chemist last week, will be in active charge of expansion of the plant. It is expected to establish the plant on basis of 500 batteries daily production. In the two years David Siegel has been operating the business the plant has had an average of 100 batteries production a day.

Dr. Elmer Ambrose Sperry of the Sperry Gyroscope Co. and president of the A.S.M.E., has been elected a Member with Distinction in Tau Beta Pi, honorary engineering society. His initiation took place in New York on April 18. He is the second recipient of this newly created honorary membership.

William J. McAneeny, formerly first vice-president and treasurer of the Hudson Motor Car Co., Detroit, has been elected president in place of the late R. B. Jackson, who died on March 19. J. H. Whittaker has been elected first vice-president and assistant general manager, and A. Barit, vice-president and treasurer.

John C. Pangborn, vice-president of the Pangborn Corporation, Hagerstown, Md., and his family sailed on the S.S. Olympic on April 5 for an extended tour of the Continent.

L. E. Guilliford has been made general manager of the Pulaski (Va.) Foundry & Manufacturing Co. He was formerly general superintendent of the McMyler-Interstate Co., Bedford, Ohio.

J. B. Clark, general superintendent of the Denora (Pa.), plant of the American Steel & Wire Co., of Cleveland, has resigned after being with the company for a period of 48 years.

Charles S. Davis, secretary and treasurer of the Warner Gear Co., Muncie, Ind., has been elected president of the Borg-Warner Corporation, of Chicago, succeeding George Borg.

H. F. Blood, formerly connected with the Hawthorne Works of the Western Electric Co., is now chief engineer of the Heald Machine Co., of Worcester, Mass.

Frank Artz, 23 S. Jefferson St., Chicago, has been appointed representative in the Chicago territory for the Detroit Machine Tool Co., of Detroit.

Ogden R. Adams has opened a new office at 407 Cutler Bldg., Rochester N. Y., for the sale of machine tools.

Forthcoming Meetings

National Metal Trades Association. Convention, Hotel Drake, Chicago, April 24-25. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

American Welding Society. Annual meeting, April 24-26, at the Engineering Societies Bldg., New York. M. M. Kelly, secretary, 29 West 39th St., New York.

American Management Association. Annual meeting, Hotel Pennsylvania, New York, May 7. W. J. Donald, managing director, 20 Vesey St., New York.

American Society of Mechanical Engineers.—Eastern Spring meeting, Rochester, N. Y., week of May 13. Third national meeting of the aeronautic division, St. Louis, Mo., May 27-30. Semi-annual meeting, Salt Lake City, Utah, July 1-4. Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

American Gear Manufacturers' Association. Thirteenth annual meeting to be held in the Hotel Statler, Cleveland, Ohio, May 16-18. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

American Society for Testing Materials. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

VOLUME of steel buying continues heavy, with production at peak levels. Prices of the principal hot-rolled steel products will probably advance 5c. per 100 lb. above the $1.90 level, which has been held since October, 1928 on large mill lots at Pittsburgh. A similar advance for the third quarter is also intimated. Unfilled orders on books of the U. S. Steel Corp. at the end of March, totaled 4,410,718 tons, against 4,144,341 for the month preceding and 4,335,206 tons, Mar. 31, 1928. In the nonferrous metals market, slab zinc rose ¼c., to 8½c. per lb., New York warehouse, while tin, lead, and solder declined. All nonferrous scrap except zinc is selling below last week's levels.

(All prices as of Apr. 12, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$18.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	24.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	15.50@16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	21.26
PITTSBURGH, including freight charge ($1.75) from Valley:	
No. 2 Foundry	19.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.25	3.90*
No. 12	2.15@2.25	3.40	3.30	3.95*
No. 14	2.25@2.35	3.45	3.35	4.00*
No. 16	2.35@2.45	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.60	3.50	3.80
No. 22	2.80@2.90	3.75	3.65	3.95
No. 24	2.85@2.95	3.80	3.70	4.00
No. 26	2.95@3.05	3.90	3.80	4.10
No. 28	3.10@3.20	4.50	3.95	4.25
Galvanized				
No. 10	2.80@2.90	3.95	3.85	4.05
Nos. 12 to 14	2.90@3.00	4.05	3.95	4.15
No. 16	3.00@3.10	4.15	4.05	4.25
No. 18	3.15@3.25	4.30	4.20	4.40
No. 20	3.30@3.40	4.45	4.40	4.55
No. 22	3.35@3.45	4.50	4.45	4.60
No. 24	3.60@3.70	4.65	4.55	4.75
No. 26	3.75@3.85	4.90	4.80	5.00
No. 28	4.00@4.10	5.15	5.05	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
⅛	$0.17	1.315	1.049	.133
¼	.23	1.66	1.38	.14
⅜	.27½	1.9	1.61	.145
½	.37	2.375	2.067	.154
⅝	.58½	2.875	2.469	.203
¾	.76½	3.5	3.068	.216
⅞	.92	4.0	3.548	.226
1	1.09	4.5	4.026	.237
1¼	1.27	5.0	4.506	.247
1½	1.48	5.563	5.047	.258
2	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—Decimal Fractions	B.w.g. and	Outside Diameter in Inches—Price per Foot ½	⅝	¾	⅞	1	1⅛	1¼
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, 5/16-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire, New York, 3/32, 8.35c.; 1/8, 7.85c.; 5/32 to 1/4, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:			
Copper, electrolytic, New York			24.75
Tin, Straits, pigs, New York			52.00
Lead, pigs, E. St. Louis	7.00	New York	9.25
Zinc, slabs, E. St. Louis	6.80	New York	8.50

	New York	Cleveland	Chicago
Antimony, slabs	12.50	13.00	14.25
Copper sheets, base	33.75	33.75	32.00
Copper wire, base	29.37½	24.50	24.87½*
Copper bars, base	32.25	32.25	31.25
Copper tubing, base	35.12½	35.12½	34.12½
Brass sheets, high, base	27.12½	27.62½	26.37½
Brass tubing, high, base	32.00	32.50	31.25
Brass rods, high, base	24.87½	25.37½	24.12½
Brass wire, high, base	27.62½	28.12½	26.37½

*At mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.00@10.50	11.70	10.11
Solder (½ and ½).....	35.00	34.00	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			70.00
Commercial genuine, intermediate grade.....			54.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.75

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	18.00 @18.50	19.00	18.00 @18.50
Copper, heavy, and wire..	17.00 @18.25	18.75	17.00 @17.50
Copper, light, and bottoms	15.00 @16.00	16.50	16.00 @16.50
Heavy lead.....	6.00 @ 6.50	6.25	6.00 @ 6.50
Tea lead.....	4.50 @ 5.00	4.25	5.00 @ 5.50
Brass, heavy, yellow.....	10.00 @10.50	12.00	11.00 @11.50
Brass, heavy, red.....		16.00	15.50 @16.00
Brass, light.....	8.50 @ 9.00	11.00	10.00 @10.50
No. 1 yellow rod turnings.	11.50 @12.00	12.50	12.00 @12.50
Zinc.....	3.50 @ 4.00	3.25	3.25 @ 3.75

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02½	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.109	.11	.113
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.2487½	.215	.165
Solder (½ and ½).....	per lb..	.35	.3475	.34
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.59	3.10
Lard cutting oil.....	per gal.	.55	.55	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.50	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.64	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		3.00
Coke, prompt foundry, per net ton...	Connellsville,		4.00
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, 7–16-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mass., Boston—J. O'Keefe, 604 Tremont St.—machinist lathe.

Mass., Boston—Old Colony Furniture Co., 1355 Washington St.—3 drum sander, belt driven for woodworking.

Mich., Detroit—Detroit Lead Pipe Works, 600 West Larned St.—pipe handling equipment for proposed 1 story, 100 x 390 ft. pipe shop. Estimated cost $85,000.

Mich., St. Clair — Buhl Aircraft Co., Marysville—assembly equipment for proposed airport. Estimated cost $500,000.

O., Cleveland—Cleveland Union Terminal Co., Terminal Tower—one 50, two 20 and one 5 ton cranes.

Tex., College Station—A. & M. College, R. D. Margurger, Supt.—is receiving bids for a pipe machine, ⅛ to 6 in. equipped with 3 ph. 60 cycle motor and controls, also complete set of nipple holders.

Ont., Welland — Bd. of Education, N. Kearns—machinery and equipment for machine and general shops for proposed 3 story, 70 x 160 ft. vocational school. Estimated cost $260,000.

Ont., Windsor—Auto Specialties Mfg. Co., Tecumseh Rd., W. H. Cantelon, Mgr.—machinery and equipment for proposed addition to factory. Estimated cost $75,000.

Ont., Windsor — Eatson Edwards Motor Sales Co., 440 London St. W.—complete equipment for proposed 3 story, 60 x 180 ft. garage and repair shop on Goyeau St. Estimated cost $100,000.

Opportunities for Future Business

Calif., South San Francisco—Enterprise Oil Burner Co., 2902 19th St., San Francisco, plans the construction of a factory at Bayshore Highway, here. Estimated cost $40,000.

Calif., San Pedro—Regan Forge & Engineering Co., Smith's Island, plans addition to plant. Estimated cost $75,000.

Calif., South San Francisco — Michel & Pfeffer Iron Works, 10th and Harrison Sts., San Francisco, plans the construction of first unit of plant to include bronze plant, foundry, service station, etc. here. Estimated cost $200,000.

Calif., Stockton — Davis & Pearce Co., Grant and Weber Sts., Archts., are preparing plans for a 1 story, 150 x 150 ft. garage at Park and Hunter Sts. Estimated cost $40,000. Owners' name withheld.

Conn., Hartford — M. Swift & Son, 100 Love Lane, awarded contract for a 2 story, 55 x 175 and 25 x 40 ft. factory, etc. for the manufacture of gold leaf. Noted Feb. 7.

Ill., Chicago—Anton Clemetsen Co., 3134 West Chicago Ave., cabinet manufacturers, plans the construction of a plant. Estimated cost $35,000.

Ill., Chicago Heights — Zowie Drawn Metal Co., plans addition to plant. Estimated cost $15,000.

Ind., Alexandria—Aladdin Co., awarded contract for a 1 story, 90 x 130 ft. machine shop. Estimated cost $43,000. Noted Apr. 11.

Ia., Waterloo — Meaney Casket Co., 311 Falls St., awarded contract for a 2 story, 35 x 170 ft. addition to factory. Estimated cost $40,000.

Kan., Wichita—Coleman Lamp Co., 238 North St. Francis St., awarded contract for a 4 story, 61 x 160 ft. lamp factory at 252-254 North St. Francis St. Estimated cost $60,000.

Kan., Wichita — Ellis & Singleton Building Co., Orpheum Bldg., will build an 8 story, 100 x 140 ft. garage and office at South Lawrence St. Estimated cost $350,000. Schmidt, Boucher & Overend, Brown Bldg., Archts.

La., Algiers—Orleans Parish School Bd., is having plans prepared for the construction of a 3 story school including manual training department, etc. Estimated cost $200,000. E. A. Christy, City Hall, Archt. and Engr.

Me., South Portland (sta. Portland) — Hunnewell Estate, c/o Edwards Sales Co., 433 Congress St., Portland, Archt., awarded contract for a 1 story, 60 x 100 ft. repair and service garage, etc. on Main St. here. Estimated cost $40,000.

Md., Baltimore—Port Development Comn., Lexington Bldg., will soon award contract for the construction of a 1 story, 32 x 84 ft. shop, etc. at McComas St. Terminal. J. E. Greiner Co., Lexington Bldg., Engr.

Mass., Beverly — P. Bonacci, 43 Federal St., awarded contract for a 2 story, 55 x 95 ft. repair and service garage on Rantoul St.

Mass., Everett (Boston P. O.) — H. K. Porter, Inc., 6 Ashland St. (toolmaker), is having plans prepared for a 1 story, 85 x 185 ft. addition to factory. Estimated cost $40,000. J. R. Worcester Co., 79 Milk St., Boston, Engr.

Mass., East Boston (Boston P. O.)—Bay State Casket Co., Elbow St., is having plans prepared for a 4 story, 60 x 65 ft. factory on Summer St. Estimated cost $45,000. M. E. Levy, 43 Tremont St., Boston, Archt.

Mass., Lynn—H. E. Pembroke, 286 Washington St., awarded contract for a 1 story, 50 x 100 ft. repair and service garage on Broad St. Estimated cost $40,000.

Mass., Malden (Boston P. O.)—S. Glick, 200 Eastern Ave., awarded contract for a 1 story repair and service garage on Eastern Ave. Estimated cost $50,000.

Mass., Roxbury (Boston P. O.)—Parker Bros. Iron Co., 363 Dorchester Ave., South Boston, awarded contract for a 1 story, 60 x 80 ft. factory at 123 Terrace St. here.

Mass., South Boston (Boston P.O.)—King Terminal Co., 50 State St., Boston, plans to rebuild 2 story factory at 74 K St. here recently destroyed by fire. Estimated cost $40,000. E. E. Erickson, 50 State St., Boston, Engr. New England Annealing & Tool Co., lessee.

Mich., Battle Creek — Consumers Power Co., Jackson, will soon award contract for a 3 story, 76 x 96 ft. service building on South Jefferson St. here. Estimated cost $250,000. Private plans.

Mich., Detroit—Ex-Cell-O Tool & Mfg. Co., 1200 Oakman St., plans addition to plant. Estimated cost $45,000.

Mich., Lansing—Durant Motors Co., Verlinden St., awarded contract for addition to plant. Estimated cost $100,000.

Mich., Lansing—Olds Motor Works, 1101 Division St., has work under way on the construction of a new warehouse. Estimated cost $300,000.

Mo., St. Louis—Bixby-Smith Inc., 10th and Locust Sts., awarded contract for a 1 story, 60 x 124 ft. automobile service building at 3223 Washington St. Estimated cost $40,000.

N. J., Jersey City—J. Goldenberg, 80 Woodland St., Englewood, is having sketches made for a 3 story, 150 x 230 ft. garage at Sip and Summit Aves. Estimated cost $500,000. C. Shilowitz, 26 Journal Sq., Archt.

N. J., Jersey City—Smooth-On-Mfg. Co., 572 Communipaw Ave., awarded contract for a 3 story, 25 x 60 ft. addition to factory for the manufacture of iron cement. Estimated cost $40,000. Noted Jan. 31.

N. J., Passaic—A. Garth, 14 Grove St., will receive bids about Apr. 15, for a 1 story, 140 x 150 ft. garage at 102-108 Gregory Ave. Estimated cost $150,000. F. P. Friedman, 395 Springfield Ave., Newark, Archt.

N. J., Perth Amboy — Raritan Copper Works, Elm St., is having plans prepared for three 1 story additions to copper plant. Estimated cost $55,000. Private plans.

N. Y., Brooklyn—M. Amorosa, 1724 68th St., plans a 1 story, 140 x 147 ft. garage at 67th St. and West 18th Ave. Estimated cost $40,000. M. J. Ort, 424 East 149th St., New York, Archt.

N. Y., Brooklyn—G. Linkowsky, 317 East 14th St., New York, plans a 2 story garage at 18th Ave. and 55th St. here. Estimated cost $40,000. M. J. Ort, 424 East 149th St., New York, Archt.

N. Y., Brooklyn—Rosmer Realty Corp., E. Rosenblum, Pres., 66 Court St., plans a 1 story, 100 x 280 ft. garage at Vanderwoort Ave. and Anthony St. Estimated cost $45,000. M. Klein, 65 Court St., Archt.

N. Y., Brooklyn—P. S. Sparrow, 1453 Union St., plans a 100 x 240 ft. garage and repair shop at 54th St. and West 21st Ave. Estimated cost $50,000. J. A. Boyle, 367 Fulton St., Archt.

N. Y., Brooklyn — Upright Construction Co., 5220 New Utrecht Ave., will build a 1 story, 100 x 108 ft. garage at 88th St. and 4th Ave. Estimated cost $80,000. H. J. Murick, 44 Court St., Archt.

N. Y., Brooklyn—G. H. Zeiner, Crown St. and Bedford Ave., plans a 2 story, 100 x 131 ft. garage. Estimated cost $75,000. G. E. Beatty, 916 St. Marks Ave., Archt.

N. Y., Buffalo—Adam, Meldrum & Anderson, 404 Main St., plans the construction of a garage and warehouse at Franklin and Niagara Sts. Private plans.

N. Y., Jamaica—C. Spindler, 164 Montague St., Brooklyn, plans a 1 story, 90 x 96 ft. garage at Van Wyck Blvd. and 95th Ave. Estimated cost $40,000. G. Lepre, 164 Montague St., Brooklyn, Archt.

N. Y., Long Island City—Anchor Cap & Closure Corp., Queens St. and Jackson Ave., plans the construction of a plant. Estimated cost $500,000. Stone & Webster, 147 Milk St., Boston, Mass., Archts. and Engrs.

N. Y., Long Island City—Ramson Realty Co., 44 Court St., Brooklyn, plans a 1 story, 100 x 126 ft. garage and repair shop, etc. at Liberty Ave. and 101st St. here. Estimated cost $50,000. L. Proskauer, 391 Fulton St., Brooklyn, Archt.

N. Y., Le Roy—F. Woodward, is having plans prepared for a 2 story, 55 x 80 ft. garage, etc. on Main St. Estimated cost $70,000. I. Cromwell, 6 West Main St., Archt.

O., Canton—Interstate Sash & Door Co., 836 Savannah Ave. N. E., awarded contract for a 2 story, 81 x 129 ft. factory. Estimated cost $40,000.

O., Cleveland—Atlas Steel & Supply Co., 4401 Trumbull Ave., is receiving bids for a 1 story, 50 x 200 ft. factory. Estimated cost $40,000. R. H. Hinsdal, Erie Bldg., Archt.

O., Cleveland — Hupp-Chandler Corp., East 131st and St. Clair Ave., awarded contract for a 1 story, 96 x 400 ft. factory. Estimated cost $225,000. Noted Apr. 4.

O., Cleveland—Motor Patterns Co., J. S. Parker, Treas., 6105 Waterman Ave., awarded contract for a 1 story, 41 x 116 ft. addition to factory. Estimated cost $40,000.

O., Cleveland—Scott & Fetzer Co., 11401 Locust Ave., manufacturers of vacuum cleaners, awarded contract for a 2 story, 50 x 216 ft. addition to factory at West 114th St. and Locust Ave. Estimated cost $60,000. Noted Apr. 4.

N. S., Liverpool—Millard Bros., plans the construction of a box factory. Estimated cost $75,000.

Alta., Calgary — Manitoba Rolling Mill Co. plans the construction of a new plant.

Ont., Windsor—Hercules Products Ltd., H. V. Welles, Mgr., plans addition to plant for the manufacture of truck bodies and equipment at Drouillard Rd. Estimated cost $300,000.